THE

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ELECTRICAL REVIEW.

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ESTIMATED AND OBSERVED VALUES OF ILLUMINATION.

YET another contribution to this much-debated subject is made by Mr. W. C. Clinton in a paper read recently before the Illuminating Engineering Society. Knowing the polar curve of candle-power distribution of a luminous source, sufficiently small to be regarded as a point, there is no difficulty in calculating the horizontal illumination which it produces directly at a certain spot. Nor is there any difficulty in determining the total horizontal illumination received directly at a given point from a number of such sources. When, however, allowance has to be made for light received by diffuse reflection from walls and ceiling, the problem becomes extremely complicated, since the effect of wall and ceiling surfaces in this connection is determined by their colour and texture, the dimensions of the room (as compared with the area enclosed by the light sources) and the polar curve of the luminous source or sources. The higher the percentage of horizontal illumination, the greater the importance of wall reflection.

In indirect and semi-indirect lighting schemes, ceiling reflection is of fundamental importance. Owing to additional illumination received by reflection from walls and ceiling, the point by point method of calculation generally gives lower values of horizontal illumination than those observed—the difference diminishing as the effect of walls and ceiling is reduced, either by their colouring or their remoteness. Dr. Bloch's "flux of light" method gives rapidly the mean horizontal illumination produced in any particular case, but does not provide the analysis of light distribution afforded by the more laborious point by point method. Another alternative is to calculate from the polar curve (by Dr. Kennelly's graphical method) the total flux liberated from the source up to any angle from the vertical and then to compare the mean horizontal illumination observed with that which would be produced did the whole flux arrive on the plane of reference. The ratio of these two values gives a "utilisation factor" for the installation.

By considering a number of typical installations, Mr. Clinton arrives at the conclusion that "light for illumination purposes is capable of estimation and measurement on an engineering basis." In cases where electric lamps are used, the discrepancy between his calculated and observed illuminations at various stations seldom exceeds a few per cent. Where larger discrepancies exist they are traceable to the source not giving the distribution and flux indicated by its polar curve. A case in point is that of a workshop lighted by gas mantles; owing to some of the latter being defective, the observed illumination on some benches amounted only to one-quarter of that predicted by calculation.

Without disparaging in the least the work performed and results obtained by Mr. Clinton, we cannot help feeling that too much time and energy is being expended on ways and means of calculating illumination. Wide variations exist in the reflecting properties of materials outwardly similar. The effects of windows, cornices and friezes are variable and difficult to determine, particularly in rooms of irregular shape.

Wide experience appears to us indispensable in securing any satisfaction from illumination calculations, and in many cases the application of this experience in another direction would permit the desired results to be attained without elaborate and tedious calculation. Where many assumptions of conditions and coefficients are involved, tabulated data, experience and common sense are likely to give at least as good results as calculations apparently more precise, and

certainly more complex in application. In many cases factors and circumstances are involved which cannot possibly be reduced to mathematical treatment, and experience undoubtedly shows that results eminently satisfactory as judged by general illuminating principles and by photometric measurements are not always pleasing to the eye.

Such installations frequently lack the charm of less rigorously "correct" schemes, while offering no real compensating advantage. Considering the many indeterminate factors involved, and the ease with which electric lighting schemes can be tested tentatively by eye and photometer in any particular case, we believe that attempts to reduce illuminating engineering to an exact science may easily be carried too far. In even the most utilitarian applications æsthetic effect is an important factor and one which can never be made purely numerical.

On Exhibitions.

In recent years, manufacturers in different sections of the engineering industry have occasionally offered organised resistance to the efforts of the private promoter of exhibitions. They objected not only to private individuals battening at the expense of an industry, but to the holding of unnecessary exhibitions at which they felt compelled to show because of the presence of competing firms. Of course there is not unanimity among manufacturers in this respect, for different classes of goods dictate different policies. Large machinery manufacturers are naturally less anxious to make displays involving large expense than are makers of smaller classes of apparatus and goods, which at almost any time may be trusted to make a profitable appeal to the popular mind when effectively shown. But we are not concerned at the moment so much with the question of general exhibition policy, as with the action of the organised machine tool makers in regard to the Shipping, Engineering, and Machinery Exhibition, which takes place six months hence at Olympia. According to correspondence received from the Exhibition managers, the Machine Tool Association has as a body refused its support to this Exhibition, and if any of its members show "will endeavour to penalise them for doing so." The B.E.A.M.A. is understood to have left its members who manufacture specialities used in the building of ships, free to do as they please regarding this particular exhibition. It is for the machine tool makers to decide for themselves what they will do, as makers of colliery machinery have done on previous occasions; if there is a good exhibition and they are not represented, they as well as the promoters may be the losers. The present indications, we are informed, are that machine tools will be the only section of engineering industry not represented. This will be regrettable. It seems to us that useful discussion might take place on the policy of Manufacturers' Associations which decide that they will not organise exhibitions at other than prolonged stated intervals, and yet will limit the activities of their members in regard to other displays.

Reactance *ad lib.*

Following at a very short interval after Mr. Hollis's paper, Messrs. Faye-Hansen and Peck's contribution to the *Proceedings* of the Institution of Electrical Engineers, which we abstracted in our last issue, further emphasises the advantages of reactance coils installed in generating stations under the conditions which now obtain. We note that the authors agree in the main with the views which we put forward in our issue of March 13th as to the proper functions of reactance, and especially as to the position where it will do the most good with the least disadvantage—namely, between successive sections of the bus-bars. The failure of one generator, one feeder, or one section of the bus-bars may thus be localised, whereas without the use of reactance the whole of the immense store of kinetic energy represented by a number of large generators running at high speed might be suddenly released with disastrous consequences.

There is, however, a risk of running to excess in this as in most other matters, and in view of the extraordinary outbreak of what we may call reactance fever which appears to be taking place in this country, we feel it advisable to suggest that full consideration be given to every aspect of the question in each case before plunging into a perfect orgy of reactance coils such as that represented by the figure from the paper reproduced on p. 610 of our last issue. Here there are no fewer than 19 large triple reactance coils in a station of 100,000 kw., and if all the feeders were shown there would be some 25 coils in all! Surely this is carrying the thing beyond reasonable limits. The fact that we have managed without reactance coils, except in a very few stations, up to the present suggests that a moderate adoption of this class of safeguard is all that is justified by the needs of the case. The remarks of Mr. A. M. Taylor at the meeting of the Birmingham Local Section of the I.E.E., quoted elsewhere in this issue, and the figure showing what is contemplated for the new power station of that city, appear to be more in keeping with the requirements. We may direct attention also to the views of a contributor on the subject, which we print in this issue.

Copper.

Since last writing, the position of the copper market has sustained some strengthening. The change for the better came from improved conditions in the United States in so far as the share markets were concerned, the stronger tone seen in that direction encouraging sentiment all round, and leading to a little—a very little—revival of speculative interest in certain commodities. It is too soon to look for any permanent revival of interest in this direction, for there is a long road to be traversed before things industrial pick up to even a reasonable extent in the United States, but there is a hope that with cheap money and better financial conditions, together with a restoration of a rather more confident sentiment, things will soon get started in an upward direction. The check experienced in trade has been pretty general, but it is proving most difficult to remove in the United States and Germany, both of which countries are even yet in a very bad way, and, indeed, so far as the position at large is to be gauged by conditions in the iron and steel sections, there is no turn for the better in sight. It is for this turn that most people are looking.

It is remarkable that with things generally as poor as they have been for so long, Europe should have proved her capacity to absorb copper at the rate witnessed this year without any inconvenience. That the shipments from America have exceeded all previous experiences goes without saying. For the 12 months ended March 31st North America shipped 409,838 tons, compared with 323,563 in 1912/1913, and 324,865 tons in the corresponding period of the former 12 months. During the first quarter of 1914 the arrivals in Europe from the United States totalled over 110,000 tons, against 88,000 tons in 1913, and 100,000 tons in 1912. The export movement from North America to Europe was, too, quite exceptional in the first three months of 1912, being at the average rate of 33,000 tons a month, while the year's average was only 28,500 tons, whereas the average for the 12 months ended March 31st was over 34,000 tons monthly. This shows the extent to which the European importations of copper have been proceeding, and in view of common knowledge as to the falling off in trade which has been experienced, and which still persists, it is not at all surprising that there should have sprung up a crop of rumours to the effect that copper is being secretly stored in some of the Continental ports.

The export movement from North America to Europe has been on a huge scale all through March, and continues, but it is a remarkable thing that the demand from this side of the Atlantic for copper should be of such an all absorbing nature as to lick up not only all the large excess available after United States home trade demands have been satisfied, but to encroach upon the stocks. It is no wonder, under the circumstances, that there should have grown up suspicions as to the *bona fides* of the export current from America, but the closest scrutiny has not been successful in revealing anything amiss with the statistical situation.

HYDRO-ELECTRIC INSTALLATIONS FOR WORKING THE MINES OF THE TEKKAH MINING CO. (PERAK, MALAY STATES).

[BY OUR BERLIN CORRESPONDENT.]

PRESENT conditions in working the tin mines of the Malay States are such as to require the use of motive power in a great number of cases. This applies primarily to mines situated in the lowlands. Not all hydraulic mines have water under a natural head at their disposal. When there is no river available in the neighbourhood of the mine, the latter is preferably worked as a dry mine, the material loosened (by hand) being conveyed upwards, and washed with the water always present in sufficient quantities at the ground level. Such mines are always exposed to a risk of being flooded, and cannot do without some form of motive power (for driving the pumps in hydraulic mines and operating the lifting gear and trucks in dry mines), if they are to be worked on really economical lines. Those few mines which are situated on the hills are not to the same degree dependent on the use of motive power.

POWER HOUSE AND PIPE LINE.

The Chinese were the first to open up the tin-bearing deposits of Malacca. They used some peculiar machines designed on the chain-pump principle and driven by the coolies themselves. When the Europeans introduced the steam engine all the mines adopted for their operation British locomotives and steam winches. However, this type of machinery, apart from its unsatisfactory efficiency, was soon found to be lacking in the mobility required for work so inconstant. Electrical operation, on the other hand, affords a number of advantages which are too well known to need enlarging on, and as the country abounds in brooks and rivers, the installation of hydro-electric plants is in a great many cases the most economic solution of the problem.

Considerations such as these, in 1910, induced the French Tin Mining Co., of Tekkah, founded with a view to the working of the tin mines situated at Tekkah, near Ipoh (Perak), in the Malay States, to have an extensive hydro-electric plant erected. The installation is briefly described below.

The river Guroh, a tributary to the Kampar, supplies the water required for the plant, under a head of about 200 metres above the Tekkah lowlands. This head is subdivided into two parts, each of about 100 metres, one of which is utilised for generating electrical energy in the power station, whilst the other supplies the pressure water required for operating the mines. The electrical energy is supplied to the Tekkah sub-station by a 9,000-volt overhead line, and is there transformed to 440 volts. The current is thence distributed to the various mines, where it is used for driving the pump motors and for lighting (at 240 volts).

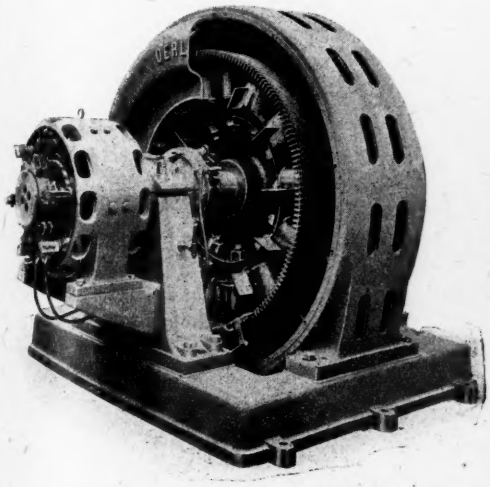
Two dams were constructed, which collect the water of the Guroh and a small tributary, leading it at the rate of 0·5 cb. m. per second into the admission conduit. This was designed partly as an open channel, and partly as a sheet-metal pipe, where the configuration of the ground required the installation of a closed conduit. It is about 3,500 metres in total length, and at three places traverses a heavy gradient.

The Ulu Guroh power house is situated at about 8 km. from the village of Gopeng, in a very narrow, densely-wooded valley.

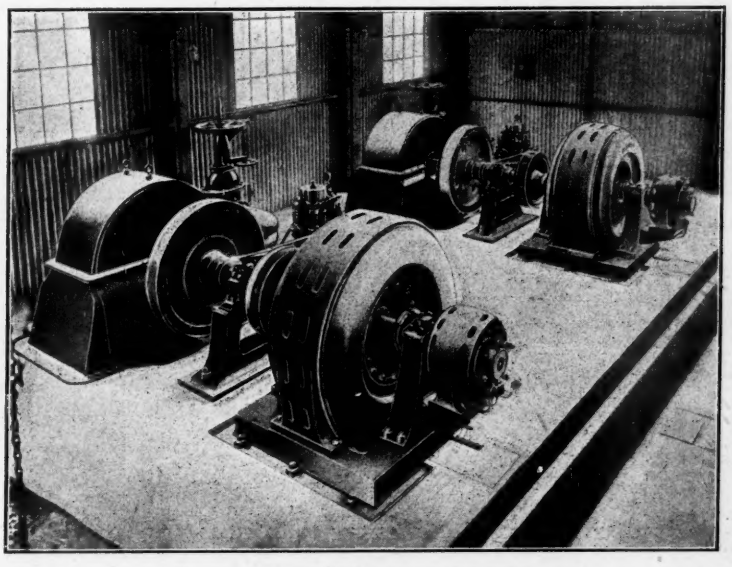
The pressure conduit is 300 metres in length, and corresponds to a water column 98 m. in height. It is made up of riveted steel pipes 700 mm. in diameter, the flanges of which are carried by masonry pillars. The material used for the pressure conduit was obtained in the country.

The power house is a two-roomed iron building, lined and roofed with corrugated iron. The larger room contains the turbines and generators, and the smaller one the switch-boards and transformers. A substantial concrete foundation, containing channels for electric lines and the turbine discharge, carries the solidly anchored iron frame of the whole building.

A valve 700 mm. in clear diameter, relieved by a special by-pass, was fitted into the distribution pipe. This is operated in the power house through the intermediary of gearing. Two other valves each 400 mm. in clear width are provided for the two turbines. A gauge in the power house permanently indicates the value of the available head of water.



ALTERNATOR OPENED, SHOWING FAN BLADES

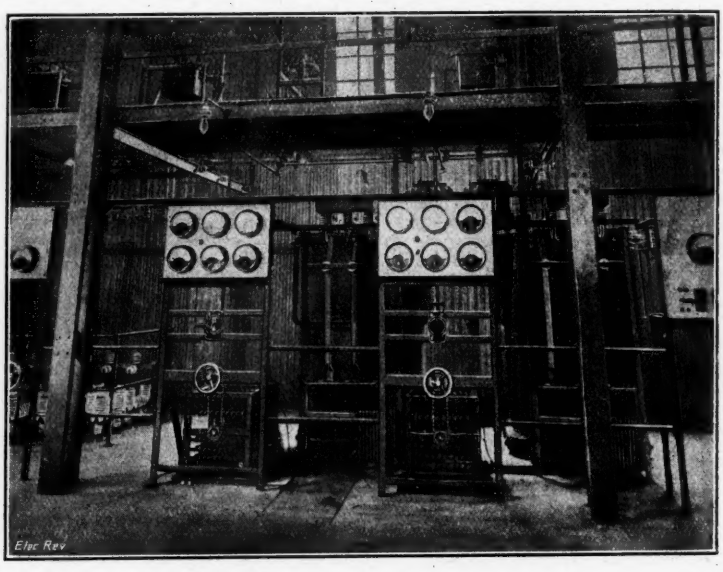


INTERIOR OF POWER HOUSE.

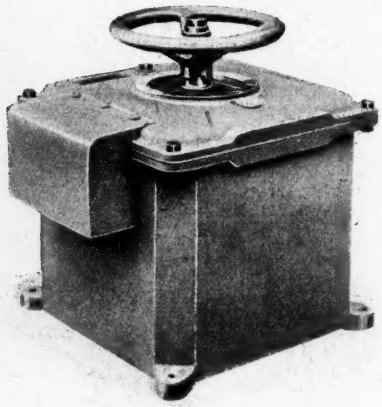
The power house contains two 500-H.P. turbine sets, working at the speed of 400 R.P.M. The turbines are designed on the Pelton system, with a single bucket wheel and two nozzles, each consuming 500 litres of water per second, under an effective head of 100 m. The Pelton type was chosen mainly in order to keep the amount of water consumed constant at all loads, thus not interfering with the working of the mining machinery operated by pressure water from belts from the turbine itself. At the normal rate of working the automatic regulators only allow quite inappreciable speed variations, the maximum deviation in the case of a sudden change from full load to zero being 10 per cent., and the speed difference between full load and zero 3 per cent.

The turbine shaft carries a fly-wheel, and is connected to the generator shaft by an elastic Zodel-Voith coupling.

The hydraulic part of the power plant was supplied and installed by Messrs. Escher, Wyss & Co., of Zurich.



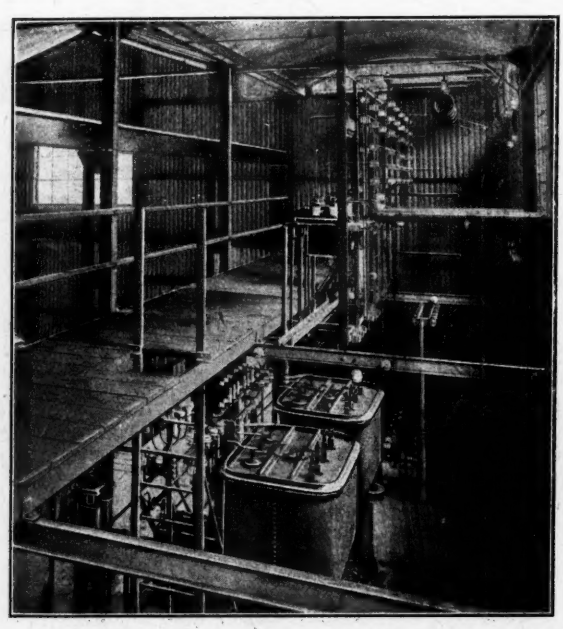
Switchgear in Power Station.



Motor-Starter.

the other half of the head. The turbine nozzles are always kept open, regulation being effected by means of two slides in the admission conduit, which are adjusted simultaneously by hand or by means of an automatic arrangement controlling the amount of water supplied to the wheel.

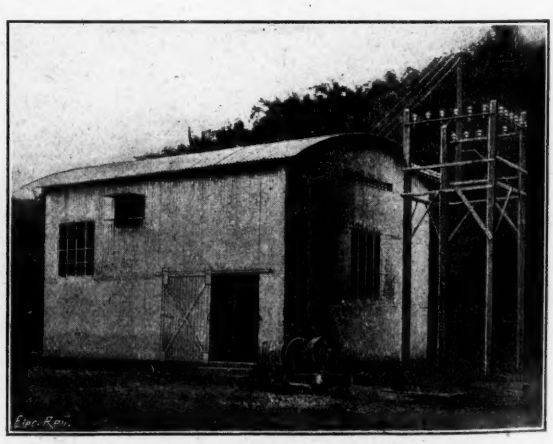
The automatic regulators, designed on Messrs. Escher, Wyss & Co.'s patented system, comprise a centrifugal governor, an oil pump and oil tank and a compressed oil servo-motor acting directly on the driving lever of the slides above mentioned. Hand regulation is effected by means of a hand-wheel. The admission conduit to each turbine is provided with a gauge, and there is another gauge on the regulator recording the oil pressure, and a speed-indicator. The regulator, oil pump and speed-indicator are driven by



Back View of Switchgear in Power Station.

The two three-phase generators are of the Maschinenfabrik Oerlikon's standard type, being designed on the following data :—Output, each, 410 K.V.A. ($\cos \phi = \cdot 83$); pressure, 400-450 volts; frequency, 40 cycles; speed, 400 R.P.M.

These generators have stationary armatures and rotating magnet wheels and are direct coupled to their exciters. The armature windings are designed as grid windings, consisting of simple copper rods (two rods per slot) placed in open slots, which can be readily exchanged. The magnet coils are interchangeable, and are made up of copper tape wound on edge; they are pressed tightly together by means of cast-steel frames joined by bolts. These frames carry ventilating vanes, which ensure a thorough cooling of the windings and poles. In view of the peculiar climatic conditions and the humidity of the air, special care was bestowed on making the insulation as durable as possible. The shaft is carried in two bearings bolted to a base plate embedded in concrete and provided with automatic ring lubrication.



Sub-station at Tekkah.

From each of the two generators there are insulated cables and massive copper conductors leading to each of the

corresponding transformers (of 410 K.V.A. and 450 volts primary pressure at 40 cycles). These are arranged in primary and secondary star connection, and are provided with oil and water cooling. The ratio of transformation is 1 : 20 with no load, the line pressure thus being 9,000 volts.

These transformers are designed on the standard core type with three vertical cores. The low-tension coils are situated close to the cores and comprise 30 windings per core, which are arranged in 10 sections, each of three copper tape windings, insulated from one another by substantial paste-board. Each section is separately wrapped with cotton tape. The high and low-tension coils are separated from one another by insulating cylinders. The high-tension coil comprises 600 windings, each of two parallel wires, arranged in 10 sections.

Cooling is effected by placing the whole transformer in an oil tank made of substantial boiler plate, which is in its lower part riveted to a cast-iron frame fitted with rollers, so as to facilitate transport. The case is widened out in its upper part, containing a seamless iron coil of pipe for water cooling, so that the active portion of the transformer can be readily removed without touching the cooling pipe. Cooling water is derived either from a brook in the neighbourhood of the power house or from the main conduit.

The switchboards are designed on the Maschinenfabrik Oerlikon's standard system without any lining. The diagram of connections was designed with a view to ensuring special simplicity and straightforwardness, so that even unskilled labourers such as are available in the Colonies might be able to attend to the plant without any risk of disturbance to the service. The high-tension conductors are made up of 6-mm. bare copper wires, and the conductors leading to the measuring instruments of plainly visible insulated wire fixed on insulators.

There are four marble meter panels, viz.: — One for each of the two generators, one for the lighting of the power house, and one for the testing voltmeter. The generator panels each contain three ammeters, one voltmeter and one wattmeter for the main current, as well as one ammeter for the exciter current.

In the secondary side of each transformer there has been inserted a main oil switch, actuated through levers from the switchboard. Below the marble slabs there are hand-wheels for operating the main current regulators. From the high-tension switches there are bare copper conductors leading to the high-tension bus-bars, whence the distribution lines are branched off. Though only one outgoing line has been so far installed, apparatus for two lines has been provided with a view to a subsequent extension. In the power house there has been inserted into the outgoing line a three-pole oil switch without automatic release, which is operated from a platform situated 4 metres above the floor. At the starting point of the line there is on the first pole outside the station a three-pole horn switch, allowing the line to be entirely switched off the power house. The testing voltmeter is, through a switch and a measuring transformer, connected up to the bus-bars.

The generators are connected up in parallel, with the aid of synchronising lamps, provision being made for their working separately, as well as in parallel, on to the conductor system. An auto-transformer stepping down the pressure to 220 volts has been provided for the lighting of the power house; this feeds 12 50-C.P. lamps.

The switchgear is completed by various safeguards, which are of considerable importance on account of the heavy atmospheric discharges occurring so frequently in that country. The high and low-tension circuits are, *e.g.*, protected by horn lightning arresters and water jet earthing devices. Generally there is only one of these sets of apparatus in operation, the other serving as stand-by.

The power transmission line is about 11·5 km. in total length. The line follows the valley of the river Guroh, and subsequently that of the Kampar, and after crossing a small hill, descends into the Gopeng lowlands.

The poles carrying the conductors are of very hard wood, obtained from the surrounding forests. They are of square section (15 × 15 cm.) and are erected at a normal distance of 45 metres apart. The maximum distance between two poles (80 metres) is at the crossing of a small valley near the river Kampar. The poles are sunk into the ground to a depth of 1·5 metres, and rest on a stone bed, ensuring a rapid drainage of water. They rise to a height of 6 metres above the ground. The conductors are hard-drawn copper wires 6 mm. in diameter, resulting in a maximum line loss of 5 per cent. at full load. A pillar switch has been provided on a frame at the Tekkah end of the line.

The insulators fixed to the poles, on galvanised iron brackets, have been designed as bell insulators, comprising three bells placed above one another; they have been tested at a pressure of 55,000 volts. One metre below the high-pressure wires there is the telephone line connecting Tekkah with Ulu, and with the place where the lower water channel terminates in the pressure conduit of the mines; this has been designed as a double line of bronze wires 2·5 mm. in diameter.

The Tekkah sub-station contains two transformers of the same type as those of the power house, having a transformation ratio of 1 : 20, that is to say, a secondary pressure of 440 volts. The secondary winding is connected to the bus-bars, whence the motor lines are led off. In order to provide for an extension of the plant to be made later on, the switchboard has been designed for four outgoing lines, though only two motors have been so far installed. The low-tension switchboard comprises four panels for the outgoing lines, each with a switchboard and an ammeter, and in addition, a panel for the common voltmeter.

At the sub-station there have further been installed lightning arresters and excess voltage cut-outs on the same arrangement as at the power house, as well as a small transformer of 30 K.V.A. and 440/220 volts supplying the lighting current for the mines and dwellings.

The two three-phase lines feeding the motors are 600 and 700 metres in length respectively, and are made up of bare copper cables comprising 19 wires 2 mm. in diameter. One of these lines feeds a motor of 100-120 H.P. working at 800 R.P.M., which through belt transmission drives an air compressor supplying the compressed air for a "Mammoth" pump. This pump has been supplied by Messrs. A. Borsig, of Berlin-Tegel, and serves to raise water and the tin-bearing earth from the mine into an ore-washing tank. The other line leads into the second mine and feeds a motor of the same design and size as the former, driving through belt transmission a centrifugal pump supplied by Messrs. Dumont, of Paris.

Each motor has its own marble slab switchboard, carrying the circuit-breaker, ammeter and fuses. Oil starters are used in starting the motors.

The mines are at present lighted by six 15-ampere arc lamps connected through transformers to the motor line, in addition to about 20 incandescent lamps of 16-50 C.P. About 100 metal-filament incandescent lamps of 16-100 C.P. have been installed for lighting the dwellings.

The telephone plant, ensuring communication between the power house on the one hand and the sub-stations and mines on the other, comprises three wall telephones and two portable telephones. Bronze wire 2·5 mm. in diameter has been used throughout.

The whole of the electrical material, apart from that for lighting the mines and dwellings, was supplied by the Maschinenfabrik Oerlikon, who, on account of their previous installations in the Malay States and other tropical countries, had extended experience in the designing of electric plants under specially unfavourable climatic conditions. A contemplated extension of the Ulu Guroh-Tekkah plant will raise the total output to 1,230 KW.

The water discharged from the turbines enters a channel 6 km. in length, whence it arrives at the pressure conduit leading as far as the mines. This conduit is about 7 km. in length, and its diameter decreases gradually from 900 to 600 mm., providing an available water pressure of 6 kg. per sq. cm. at the place of operation. This water is used for the operation of monitors having discharge openings 5 to 7·5 cm. in diameter, the direction and position of which can be adjusted at will by means of a simple lever. The issuing water jet serves to loosen the tin-bearing earth, which, as above mentioned, is, along with the water, raised by pumps.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Appointment of an Assistant Electrical Engineer.

Men who fear to approach their chief are evidently not wanted in Worthing, and therefore "Chief Assistant" has a well-founded grievance against those responsible for the advertisement. It is, however, a pity that strained feeling should arise when an assistant attempts to better himself. A chief ought to welcome the confidence of his employés who seek his assistance in their endeavours to get on.

Sometimes the assistant is to blame for making too frequent appeals for rises, concessions, testimonials, &c., which indicate restlessness, and possibly discontent, and the latter is an abomination to any chief. Zeal and ambition must be tempered with discretion on the part of the assistant, otherwise even the best chief may turn and rend him.

As to signing the offensive document, I plead guilty of having done so. In so doing I relied upon my assistant's integrity for one or two items not personally verifiable, believing this to be all that could be expected.

Chief.

Cottage Lighting.

Charge for lamps at the rate of 6d. each as security; if the average renewals do not exceed one per annum, the amount paid to be refunded to the tenant on leaving. This would serve as security for payment of current accounts, and reduce renewals cost.

Mr. Fennell's scheme for free wiring should only apply to existing property; in the case of new property, offer to put in the installation at an inclusive charge of, say, 5s. per point while in course of erection, fittings and lamps to remain the Corporation's property.

It might be possible to give the consumer a rebate at the end of each year, when the units consumed are below a fixed number, thus encouraging economy and keeping an eye on the next-door neighbour. The landlord or his agent would surely collect accounts and guarantee payment; in many cases it is the custom for the agent to guarantee weekly payments for rent, and collect at 7 per cent. to 10 per cent.

The landlord, if he acted as collector, would probably include electric light in his rent, as the 7 per cent. on revenue from the use of electric light would be clear profit to him, and give him an interest in securing new consumers.

Arthur C. Greig.

London, N.

Electricians and Pipe-fitting.

Having read your leader in the REVIEW of the 3rd inst. *re* the dispute between the E.C.A. and the electricians of London, I note with some astonishment your suggestion that "pipe-fitting" is an unskilled part of the electrical installation. If this is so, how is it that we who have served our apprenticeship to a firm of contractors ever had anything to do with it? While an apprentice myself I was always led to understand that the erection of conduit was part and parcel of the trade, and required quite as much skill as the actual wiring. After working in the trade for seven years, I am still of the same opinion, which makes me think that the writer of the article never did any "pipe-fitting."

Wireman.

[The point of the article in the part referred to was that the masters were to a certain extent justified in calling the merely mechanical part of pipe-fitting lower-grade work than the running and connecting of wires; it was not suggested that it was entirely unskilled work, and the proposed rate of pay, which is intermediate between unskilled and highly skilled, proves this.—EDS. ELEC. REV.]

Lighting of the I.E.E. Theatre.

We have read with interest the discussion on the various forms of lighting, and think that the fact that there is an inverted arc lamp, the effect of which is really shadowless, on the market, may be worth the notice of those concerned.

The old open-type inverted arc lamp is no doubt fairly efficient as regards the light given from the lamp, but its effect on the ceiling and surroundings is very much marred by the harsh shadows which are cast by the various fittings at the top of the lamp.

Mr. Justus Eck's remarks as to the advantage of having to trim the lamps are well founded, but open-type lamps are at a considerable disadvantage, in that their burning hours are so short, and they, therefore, require attention much more often than mere cleaning would demand. This is the reason for the introduction of the inverted-enclosed lamp, in which the burning hours are six times those of the open-type lamp and are sufficiently long to enable the lamp to be used, in most instances, for a whole week without attention.

Pure indirect or semi-indirect lighting when correctly obtained is quite satisfactory, and the lamp mentioned above solves the problem.

Interested.

Creosoting Wooden Poles.

The following information may be of value to "Ta Tao":—

The writer has erected in Western Australia wooden poles carrying heavy mains, and after long experience and repeated test and trial, the following was found to be the only satisfactory method of treating them.

White gum poles 24 ft. long, 10 in. bottom butt, 4 in. top, were used. I was fortunate in being able to secure some lengths of old 12-in. cast-iron pipes, and cut them into 4-ft. lengths; with these I "shod" the bottom butt of the poles to a length of 3 ft. 6 in., leaving a clear 6 in. of pipe at the base, which I filled with concrete. The pipe extending 3 ft. 6 in. up the pole, and being 12 in. in diameter, left a space into which I drove wooden wedges round the sides. I then poured about a pint of paraffin oil into the space between the pole and the pipe, and after allowing sufficient time for this to dry, I filled up with cement.

I might say that this is the only method of treating wooden poles against white ant, dry rot and wood insect engendered in the poles.

G. L. Duthoit.

Loftus-in-Cleveland.
April 10th, 1914.

Protection or Tyranny?

With reference to the recent correspondence in your columns on the above fascinating subject, we have been much interested in the letters of "Junius" and also of Mr. F. W. Purse. The former is gratified that the chairman of the Council of the B.E.A.M.A. has honoured him with his attention, and attributes this to his pen-name.

We do not, however, think that he has any real cause for gratification, and his insinuation, in this instance, that the B.E.A.M.A. is playing the same game of spoof as the House of Commons is somewhat misplaced.

We have been members of the B.E.A.M.A. since its incorporation, and were members of the National Electrical Manufacturers' Association before that, and it may interest "Junius" to know that not merely have we never heard of such a rule existing, but we have never heard it discussed; in fact, if it exists anywhere, it has nothing whatever to do with the B.E.A.M.A.

Who are the grades of workers who are dissatisfied with the working of the B.E.A.M.A.? Some of the members themselves may be, but this hardly affects "Junius," and he is presumably not referring to the possible divergence between the larger and smaller firms of the Association. If he be, we should suggest he considers the composition and the controlling interests of the larger firms.

As far as Mr. Purse's complaints are concerned, we have been in the electrical industry for many years, and have no doubt that Mr. Purse was really joking when he suggested that the poor British manufacturer was tyrannising

over the municipal buyer. The B.E.A.M.A. are only trying to lay down fair and reasonable conditions because of the grossly unfair conditions issued by many public officials. Some clauses, such as the municipal engineer being his own arbitrator, and paying for goods 12 months after he put them to use (not after he bought them), are examples of their fair-mindedness. It is doubtless the same class of public official who, when a manufacturer calls upon him with, as far as he may know, an epoch-making device, of which the engineer is entirely ignorant, sends out a message "not wanting any to-day," as if the milk cart were on its rounds. As a further example of tyranny we would suggest that Mr. Purse peruse the correspondence in your issue of April 3rd, on "Appointment of an Assistant Electrical Engineer."

What Mr. Purse apparently fails to realise is that it is only combinations of very large firms that can force the buyer into subjection to the seller. His remedy is to buy from the smaller firms wherever he can, but in no case ought Mr. Purse to be allowed to buy from German manufacturers, who exercise a far worse tyranny in their own country and employ cheap labour.

Some day the British workman will wake up and rend the buyer of foreign manufactured goods.

Facts.

"Situations Vacant" Advertisements.

I would suggest that much time and trouble could be saved by both advertisers and those replying to advertisements if an indication were always given as to the locality of any berth vacant when advertised under a Box No.

I do not mean that it should be detailed, but just a word or two, such as Manchester district, in or near London, South-Western county, &c.; perhaps, also, a hint as to whether Corporation, private supply company or manufacturers' works—where the same is not clear from the context of the advertisement—could be included without the use of more than an extra four words.

This would obviate answers being received from those who have no intention of going to certain districts (or, say, leaving London), and so save the time of advertisers should any such application be entertained by them, and would also be of great service to possible applicants.

G. M.

London, S.W.

The Modern Motor.

As an experienced man I was much interested in the article on "The Modern Motor" in last week's issue of the Review, written by Mr. E. F. Butler. Having had the care and control of large installations, both direct and alternating, up to 20,000 volts, three-phase, perhaps my opinion on modern motors and generators may be useful to many readers. I quite agree with Mr. Butler on those points dealing with the general inaccessibility of the parts of "modern motors," but, at the same time, flatly refuse to believe they are superior in performance (*i.e.*, doing work). To quote a few out of many old makes of 10 or 15 years ago, let me mention those made by the General Electric, America; Thomas Parker, of Wolverhampton; Mather and Platt, Manchester; the Union Electric Co., England; Crocker-Wheeler, Newark, America.

I can assure Mr. Butler that the old motors made by these people 10 or 15 years ago are, in several cases to my knowledge, running as well to-day as ever they did. It is a rare sight to see one of these old armatures out for repairs; notice the beautiful long commutator, with its thick segments. I have had the pleasure of taking out many of these old armatures and comparing them with the present-day rubbish, with the winding section cut down as low as ever it dare go. Not only is there a reduction in good metal, but the present-day armature has not the sound workmanship about it which is so noticeable on comparison with the 15-year old stamp. Motors are not built now for rough work, or for taking adrift easily either. It took me five hours to draw the brass sleeve off a 36-h.p. motor which had seized, even with the oil-well quite full of oil; another 5-h.p., with a white-metal sleeve, seized under similar conditions, and it had to be broken away. It appears to me that these present-day bearings are turned up to dead size whilst quite cold, but, with a load coming on suddenly, they are very apt to seize unless sufficient clearance is left for warm running. Of course, as regards brush gear, flashing over is caused by a great distortion of the field causing heavy brush sparking; I may say that this is more the case with generators than with motors, and is often due to brush gear being monkeyed with and thrown into wrong position whilst under a heavy load. A fixed brush, in my opinion, is far superior to those of the wobbling, loose-shoe type, which always get burnt either at the front or back through rocking on the commutator. The brush-holder should swing from the spindle by the aid of flexible copper strips as in the case of the Crocker-Wheeler type; the brush is gripped firmly in the shoe, and can be properly bedded down, and tension can be applied as the brush wears down in exact proportion. The present-day motor is too cramped altogether, in fact many of my motors cannot be got at to touch up the commutator unless the brush gear is taken right away; this means taking all one end away. The ring oiler bearing was a marvellous invention, and far superior to the drip-fed bearings on the older machines, which required close attention. The rings should be quite visible and accessible by the lifting of dust-proof lids from the outside of the spider castings. A small flash lamp is the proper thing to use to inspect the rings, to see if they are turning and picking up oil properly.

Henry Fowler.

Liverpool, *April 13th*, 1914.

LEGAL.

Kidderminster Tramways Case.—Cross Claim for Damages.

(*Concluded from page* 616.)

The hearing was continued on Friday, April 3rd.

Mr. Hugo Young, at the suggestion of his Lordship, in opening the case for the defendants, included in his address his opening of the case for the plaintiffs in the action of Woodward, Grosvenor and Co. against the Tramway Co. He said that the only point in the action was the simple issue whether the making of the tunnel had in any way affected the tramway track, and if so, what was the amount which it would cost the Tramway Co. to make good the damage. The defendants obtained the consent of everybody, including the Public Works Committee, to open the road. One thing was clear, and that was that it was not an honest complaint of injury to the tramway and a desire to recover for the damage done—to recover a few pounds for making good the track. It was manifest that the object of the plaintiffs had been—they being the electric lighting authority as well as the tramway owners—to keep the defendants from laying their cable so as to enable them to supply themselves with electric light, instead of taking the plaintiffs' supply, which was not suitable. Notice was given to them of the defendants' intention, and therefore there could be no complaint that they were not fully warned. On July 29th they applied for and obtained an injunction against the defendants to restrain them from interfering with the tramway. A curious thing about the injunction was that Mr. Lycett, the managing director of both companies, acted for the moment as a solicitor's clerk, coming down to serve the injunction personally upon the defendants, when he intimated to Mr. Woodward that he was going to try and prevent him from getting the light. When he could not persuade the defendant to abstain from laying the cable, he said something to this effect:—"You know we are a big company, and we are going to see this thing through." Heavy expenses had been incurred in trying to stop the defendants. The injunction was obtained, but when the summons was heard there was no order made beyond that they were not to interfere with the tramlines. The defendants did not want to interfere with the tramway, and an undertaking was given that they would not do so. The work was done upon the assumption that they might do it if it could be done without interfering with the tramway. Tracing the history of the case, counsel said that on September 16th the tramway people took steps with the object of destroying the cable, and further legal proceedings were taken by the defendants to restrain them. The whole thing was based upon the circumstance that on September 16th, when the company had occasion to repair their line, they found the crack in the concrete, upon which they set themselves to discover that the defendants had done some injury. He would be able to show by evidence that the concrete at this particular place was cracked as far back as 1912, a long time before the defendants ever went near it. A strong reason for saying that the tunnelling did not necessarily cause damage was to

be found in the fact that a second cable which the defendants had laid had existed up to the present time without the slightest injury being discovered. It was common ground that there was a depression in the road when the defendants began to do their work, but that was not caused in any way by them. The plaintiffs, however, were trying to make out that it only began as and from September 2nd, when the tunnelling work was started. He did not dispute that there was a crack, but he maintained that it had existed 12 months before. Although it was admitted that the cable was doing no harm at present, the Court was asked to order that it should be taken up. No Court could make such an order as that, because the land beneath the tramway was not the property of the company. Their claim, if they had any, would only be to have their line made good.

His Lordship said if it could be shown that the cable was likely to cause injury, he would have jurisdiction; but it was manifest that the cable was as solid a substance as anything that could be put in to take its place. The fact seemed to be that the cable was sought to be removed in the interest of the Electric Lighting Co., and they had no right to do it.

Mr. Young then proceeded to state his case as the plaintiff in the second action. He said, assuming they had got the cable in improperly, and that some injury was caused to the tramway in consequence, the extent of the Tramway Co.'s rights was only to compensation in damages. Before discovering any injury at all, however, they came down armed with counsel's opinion and instructions to take out a piece of cable so as to destroy its effective use for electric lighting. The cable did not injure them in any way except as an electric lighting company. They came in the dead of night and hoped to cut the cable and fill in the hole without being seen. If they had succeeded, Messrs. Woodward would have been put to enormous inconvenience and expense, and damages were now claimed for injury caused by the cutting, and an injunction was asked for restraining the Tramway Co. from doing the same thing in future.

Evidence was given by Mr. G. W. Grosvenor, managing director of Woodward, Grosvenor & Co., Mr. C. J. Jeffreys, manager for Thomas Vale & Son, contractors, of Stourport, who carried out the tunnelling work, Mr. James, the borough surveyor of Kidderminster, and Mr. A. Ritchins, road foreman to the Corporation of Kidderminster.

The hearing was continued on April 4th, when several witnesses, Corporation officials, and contractor's workmen, were called to give evidence as to the character of the subsoil under the tramline, and the manner in which the tunnelling work was done, and what happened when Mr. Charlton attempted to cut the cable. Mr. Wm. Hy. Griffiths, electrical engineer and manager of the Birmingham branch of the A.E.G. Electrical Co., gave evidence as to the nature of the soil where the tunnel was cut.

Mr. Frank Ernest Jones, foreman of the engineering and mechanical department of Woodward, Grosvenor & Co., and Police-Inspector Geo. Smith, also gave evidence, and the case for Messrs. Woodward was closed.

Mr. Eustace Hills, addressing the Court upon the whole of the two cases, contended that the Tramway Co. having to make and maintain their line, no one could come and tunnel under the road in such a way as to let them down, and the Town Council, as a matter of fact and a matter of law, could not give anyone leave to open up the road within the tramway jurisdiction. He said that the material point was whether the tunnel caused injury to the concrete bed of the tramway, and he contended that it did interfere with the support, and so with the tramway itself. Mr. Eustace Hills continuing his speech on behalf of the Tramway Co., on Monday, April 6th, argued that Messrs. Woodward, Grosvenor and Co. had no actual possession upon which they could rely upon which to found their action. They had not abandoned their cable, but it became part of the soil when laid. If it could be said that they had constructive possession, it would not give them the right of action without title.

Mr. Justice Rowlatt: It was attached at either end to their works, and they were sending an electric current through it.

Mr. Eustace Hills submitted that one of the tests would be whether the cable could be removed without disturbing the rights of anyone else.

Mr. Hugo Young, in his reply, maintained that Messrs. Woodward & Grosvenor had a right to sue for the damage to their cable. They had never parted with their physical possession of the cable, and it was with the acquiescence of the owners of the soil that they laid it. The Courts had held that in cases of this kind there was not any "passing" of possession merely because the cable was put in the soil.

Mr. Justice Rowlatt, in giving judgment, said that the action had taken a long time to try, but that time was fully justified by the importance of the matters concerned. The first action was by the Tramway Co. for damages, and an injunction in respect of two tunnels under the tramline, and the only question was the effect which those tunnels had upon the tramway. It was not in dispute that the plaintiffs had the right to run their tramway upon the street without being interfered with by any excavation in the subsoil and the road, and the question was whether any damage had been caused by the defendants. In any event the damage was not serious. The line at the point in question had been condemned, and would have had to be renewed in the course of two or three years, and the damage caused by the defendants, if any, was to a very small amount. In his judgment, it would only amount to the interest in respect of anticipation of repairs. The damage would really be less than £10; but the question was whether the plaintiffs had made out the case that the line had been damaged by either the first or the second tunnel, and the attention of the plaintiffs had been directed to the fact that the tunnel was about to be made, and one would have thought that the plaintiffs who had been given rights over the public streets, would feel that it was their duty to see that the tramway was not interfered with. One would have thought that the matter would have been arranged between the parties, and any danger which it was thought might result would have been pointed out to the defendants. But, unfortunately, that was not the course pursued. It appeared that the electric tramways had directors who were also directors of the local Electric Lighting Co., and it was as clear as anything could be that those people resolved to use their tramway for the purpose of preventing Woodward & Grosvenor from supplying themselves with electricity, and coercing them into taking the current from the Electric Lighting Co. On July 29th the Tramway Co. obtained, *ex parte*, an injunction, and the extraordinary course was taken of Mr. Lycett, the chairman of the company, coming down and serving the injunction personally upon the defendants. Mr. Lycett then said that they wanted to supply the electricity themselves. Mr. Grosvenor told him that it was not the kind of current they wanted, and that they preferred to provide their own. It appeared that Mr. Lycett tried to intimidate Mr. Grosvenor into taking the electricity from him. The only respect in which the defendants' freedom of action was limited by the injunction was that they were not to injure the tramway. No suggestion was made for the protection of the tramway, but the plaintiffs thought fit to adopt measures which threatened a breach of the peace. They thought fit to hire 41 navvies and occupy the trench, so that the defendants could not carry out their work, and it was only by the intervention of the police that the intolerable interference was put an end to. It did not come very well from such people to complain that the work had not been done in the best possible manner. On September 16th, without giving notice to the defendants, the plaintiffs came in the night, and digging down to the tunnel which the defendants had made, they cut the cable. Whether they dug down to separate the connection by taking out the piece, or merely to cut it through, seemed to be immaterial. That it was their intention to destroy the connection he was satisfied. It was suggested that they did it because the cable was illegally laid. If it had been illegally laid, it had not caused any infringement of the rights of the plaintiffs. It was not illegal in the sense of it having been laid without consent having been obtained. It was then suggested that it was illegal because it was dangerous to the tramway; but when it had been laid it formed a solid mass in the soil, and was as safe a foundation for the tramway to run over as if it had been solid stone. The real reason was to get down to the cable and sever it. The whole thing was utterly illegal. It was a malicious injury to property, and being done at night might have been followed by a penalty of penal servitude. But when the police stopped this malicious injury, they thought fit to overbear the police by saying that they (the police) were obstructing Mr. Charlton in his rights. In an affidavit put in for the plaintiffs, it was said that the police appeared to be acting under the direction of Messrs. Woodward & Grosvenor, but that was a monstrous position to take up, as the police were merely doing their duty. The object clearly was, the cable having been injured, to cover up the place and prevent Woodward & Grosvenor from discovering where the interruption in their current was. Here they had the tramways, for an indirect motive, trying to make out that the interest which they had in their tramways entitled them to interrupt the enterprise of Woodward & Grosvenor. They tried to get the Corporation to interfere, they tried to intimidate the defendants themselves, but all to no purpose, and they then committed a breach of the law and tried to overbear the police. They had been wrong in every point throughout, and he was satisfied that the tunnels did not give cause for complaint. The tramway people did worse than the defendants were charged with having done, because they removed the soil immediately beneath the concrete when they tried to get down to the cable to cut it. He came to the conclusion that there had been damage to the concrete before any of the things complained of happened, and that the depression in the line was due to that damage. The onus was upon the plaintiffs to show that damage had been done, and they had failed to do so. The plaintiffs' action must be dismissed as to the first tunnel, and as to the second tunnel he would grant no injunction whatever. As to the cross action in respect to the separation of the cable of Messrs. Woodward, Grovenor & Co. by the Tramway Co., there was no defence at all except the contention that the plaintiffs had no such interest in the cable as would entitle them to maintain and keep it. That point had given rise to an interesting legal discussion. The plaintiffs assumed rightly that they had the sanction of the owners of the soil to lay the cable which consisted of three strands of copper wire laid in a pipe to connect their dynamo on the one side with their works on the other side of the road, and it was put in the soil to keep it out of the way. It appeared to him that it would be very astonishing to hold that the property in that cable, as separate from the soil in nature, so distinct from it and so isolated from it, passed to the owners of the sub-soil. The question was whether the plaintiffs had sufficient interest in the cable to maintain an action against a mere wrong-doer, and he thought they had. The cable was laid in the soil, but it remained the property of the plaintiffs. The objection to the action, therefore, failed, and there was no other defence. The actual damage was £28, but the case was one which was attended by exemplary damages. All the trouble had been brought about by the course which the defendants had taken, and he gave judgment for the plaintiffs in the cross action for £100.

Judgment was therefore entered for Messrs. Woodward and Grosvenor in both actions.

Attorney-General at the Relation of the Long Eaton Gas Co. *v.* the Long Eaton District Council.

In the Chancery Division on Friday, April 3rd, there was opened before Mr. Justice Sargant this action, which was brought to decide whether the Council were justified in making a differentiation between consumers of their electric supply.

Mr. Mark Romer, K.C., and Mr. Percy Wheeler were counsel for the plaintiffs, and the defendants were represented by Mr. Martelli, K.C., and Mr. Courthope Munroe.

Mr. Romer, in opening the case, said that the action was brought at the relation of the Gas Co., who had the right of supplying gas in the district, the defendants being the Urban District Council, who had powers for supplying electrical energy for light and power within their district. The plaintiffs claimed a declaration that a certain differentiation in the charges which the defendants were now making for the supply of power was a differentiation which contravened Secs. 19 and 20 of the Electric Lighting Act of 1882. Those were the sections which related to the giving of undue preference. The facts of the case were very short, and might be very shortly stated. The defendant Urban District Council obtained its statutory authority to supply electrical energy under the Local Council Electric Light Order of 1900. Long Eaton, the district supplied by this Council, though in the county of Derby, was close to—he understood only 8 miles from—Nottingham, and was right in the centre of the lace manufacturing district. There were within the district supplied by the defendant Council a large number of lace factories—factories where machine-made lace was manufactured. These factories might take both their power and light from the defendants, or they might do one or the other of these things by gas, or they might do both by gas. Down to the time of the differentiation of charge of which the plaintiffs complained in this action, the Urban District Council charged the same rate for power supplied to the factories which were also lighted by electric light as they charged for power to factories lighted by gas. Likewise, the same charge was made for electricity for lighting purposes to factories whose machinery was driven by electric power as was made for light to factories whose machinery was run by gas power. In September of 1911, however, the complaint of differentiation commenced with the issue of the following circular from the Long Eaton Urban District Council, dated September 25th, 1911, from the electricity supply works, Long Eaton. It ran :—

"Dear Sir,—I am directed by my Council to inform you that the following resolution has been adopted with reference to the price charged for electricity to power consumers, which will take effect as stated therein, viz. :—

"*Revision of Electricity Charges.*

"The Committee, having fully considered this matter, recommend that the present scale of charges remain in force where power and lighting are both taken exclusively from the Council electricity mains, but in cases where electricity supply is taken for power only, or for power and partial lighting, the lowest scale of charges where the number of units consumed during any quarter exceeds 4,000 shall be 1d. per unit, and otherwise according to the existing scale, such amended charge to commence on January 1st, 1912.

"I enclose herewith the scale of charges for electricity referred to in this matter.

"(Signed) Frank Worrall,
"*Engineer and Manager.*"

That scale of charges, continued Counsel, was for over 4,000 units and under 6,000 1d per unit, and over 6,000 units ¾d. a unit. The result was that there was a differentiation made by this circular from January 1st, 1912, the effect of which was to put up the price to those who did not light entirely by electricity. Where a man lighted his factory by gas, or partly lighted it by gas, instead of ¾d. a unit for a supply of over 6,000 units a quarter, he would have to pay 1d. per unit. A differentiation, said Counsel, to the extent of a ¼d. per unit in favour of those who exclusively lighted their factories by electric light. His submission was that such a differentiation was forbidden by Secs. 19 and 20 of the Act of 1882. Undue preference as used in Sec. 20, must, he submitted, mean a preference that was undue with reference to what was insisted on in Sec. 19. That was to say, that if the undertakers purported to attempt to discriminate between consumers who under similar circumstances were entitled to a corresponding supply, then they were guilty of an undue preference. If under the existing scale of charges the discrimination was against persons who used the light only which was produced at the time of the maximum load, it would not be a controversial matter but rather a matter of common sense. Either the differentiation was because they wanted to obtain the custom for lighting from the people who were using the energy for power, or because they thought that in that way they would be able to obtain the customers of the gas company. It was a differentiation for the purpose of rival trading. If their object was to increase their new customers, they were not entitled to do it by discriminating against their old customers. They had already differentiated between houses and factories, and it was difficult, therefore, to understand any valid reason that would justify the change that had been made.

Counsel proceeded to deal at length with the authorities largely with reference to the carriage of goods, for the purpose of showing that where different rates had been allowed it had been shown that there was a difference in the cost of providing the carriage.

On Monday, April 6th, Mr. William Ernest Radford, who was called for the plaintiffs and examined by Mr. Romer, said that he was a lace manufacturer at Long Eaton. He used electric power and originally desired to use gas for lighting. He had a lot of gas fittings, but in consequence of the Council's circular he took the electric light. His factory sometimes worked for the whole 24 hours, but the usual hours were from 4 a.m. until midnight. Sometimes his machines stood idle and he would then be using the electrical energy for light alone. There were frequent occasions when he was using the energy for light when he was not using it for power.

Cross-examined by Mr. Martelli, witness said that for the winding machinery he employed women and girls and their hours were limited by the Factory Acts. The hours the winding machinery would be working were from 7 a.m. to 7 p.m. The load on the other machinery would go on to midnight, the time when the electric light would be used; he used about one-tenth of the energy for lighting that he did for power.

Mr. George Stevenson, director of the Long Eaton Gas Co., said the shed factories usually were supplied with electric power. There were four types: those which took electricity for power and gas for light, those that took electricity for both power and light, those that took steam for power and gas for light, and those that took steam for power and electricity for light. The general principles of charging were the same in both the gas companies and the electricity companies. Generally speaking, light would not be required by the factories when they did not require power.

Mr. Harold B. Stretchley, lace manufacturer of Nottingham, said that his factory at Long Eaton was erected in 1904. In consideration of his taking electricity for light, the Council cancelled their increased charge for power. There was a separate meter for the light and for the power. He would not be using the light when the power was not being taken. It would be very exceptional if he did. In 1912 he was enlarging his factory, and he asked the Council to give him the reduction from that time.

That concluded the plaintiffs' case, which was summoned up by Mr. Percy Wheeler.

In opening the case for the defence, Mr. Martilli said it had an importance beyond that to the present parties, for it was a common practice now for suppliers of electricity to charge one rate where the energy was taken for power only, and another where both power and light was taken. The analogy between this case and cases of railway rating, must not be carried too far. In the case of the railway rates the effect was to the price of the goods supplied, but then the Courts were considering the charge for the carriage of goods, and how it was considering the charge for supplying goods. As he understood it the questions which his Lordship had to decide were three. First of all under Sec. 19 did the customers for power get their supply under similar conditions to the customers for both power and light, for the words of the Section were that it was customers who were taking a supply under similar circumstances that were entitled to a corresponding supply. The first question, therefore, was were customers for light and power customers taking a supply under similar circumstances? The next question was did the former—that was that people who used the current for both power and light get a corresponding supply to those who used it for power only? The third question was whether there was any question of undue preference under Sec. 20? The defendants asked his Lordship to answer all those questions in the negative.

Mr. Justice Sargant: Is your contention that taking the two first questions, in order for the plaintiffs to succeed I shall have to answer both of them in the affirmative? One would not do?

Mr. Martelli said that was so. He proposed to deal with the case first of all on the assumption of there being no question of partial lighting.

Mr. Justice Sargant: If it is bad as to part it must be bad as to all the rest?

Mr. Martelli: That must be so with regard to the first question. He said it was important to remember that all these factories in Long Eaton were worked under normal conditions. They were practically worked 20 hours out of the 24.

Mr. Justice Sargant said that he thought that was the evidence given by the plaintiffs' witnesses.

Mr. Martelli said that one further point was that when they were not working up to their full normal time they would work in the daytime in preference to working at night. The evidence was that 20 per cent. of the winding machine work was done by women, and those women could only be employed in the factory for 12 hours, and those were the daylight hours. From 7 a.m. to 7 p.m. were practically the daylight hours, and at 7 p.m. a substantial part of the power was shut off, the defendants thought 25 per cent. at least. When, therefore, the energy was taken for power only, at 7 p.m. 25 per cent. of the generating plant would become idle, and would remain idle until 7 o'clock the next morning. The figures showed that the day load was seven-tenths of the total load, and it must be an advantage to compensate for the falling-off of the day load by getting users for lighting purposes at night. The maximum power load was always during the day. It must also be borne in mind that light was four times the price of power. Power was ¾d. per unit and light was 3d. per unit. Counsel did not suggest that the principle he was contending for would apply when something besides electricity was supplied. For instance, the Council could not make a difference in the price of electricity to a consumer because that consumer took coke from them, but he did submit that they were entitled to differentiate in their charges for electricity between what he might call a good and a bad customer.

Mr. J. F. C. Snell, examined by Mr. Munroe, said the load factor of the station was 26·01 for the year ending March, 1913. Load factor was an important point, because the load factor of the con-

sumer determined the load factor at the station. The better the load factor the cheaper the undertakers could afford to sell, because of the less cost to them. Another factor was what was known as the diversity factor of the load. A supply company had to provide plant for the maximum load. In the case of the defendant Council it was 950 KW., which was the amount installed, whereas 658 KW. was the maximum required, giving a margin of over 300 KW. odd. The increase of the electric light demand would tend to improve the diversity factor. For that reason a consumer taking a supply for power only, and one taking power plus light, could not be said to be taking a supply under similar circumstances. The load factor would not be the same. There might, however, be cases where the load factor of the person taking energy for power only would be better than that of one taking power plus light. As a rule, however, it would be the other way about. Apart from the special case, the load factor of the person taking power only and the person taking power plus light, would be different. The load factor of the person taking both would be the better. At Long Eaton the consumer of power plus light would have a slightly better load factor than consumers of power only. Speaking generally, in Long Eaton the person who took both power and light was the better consumer from the Council's point of view.

Counsel asked whether it was a commercially sound principle to give preference to the consumer of both?

The question was objected to, and counsel said he merely asked it in case it was suggested the preference was given merely to injure the gas company.

MR. ROMER said that was not suggested.

MR. FRANK WOBRALL, A.M.I.C.E., engineer of the Long Eaton District Council, said he had had charge of the electricity works of the Council since 1900, when the provisional order was obtained. Long Eaton was purely a manufacturing district; before electricity was introduced, the motive power for the factories was either steam or gas. They had had one case of a factory lighted partly by gas and partly by electricity, and in that case the consumer was given the benefit of the reduction. That was the only case of the kind they had had, and he thought it extremely unlikely they would have another. They charged less for power than they did for light, because they could use the machinery for power when it was not required for lighting purposes.

MR. WILLIAM JENKINS, vice-chairman of the District Council, and chairman of the electric light undertaking, gave reasons for making the differentiation.

That concluded the defendants' case, which was summed up by MR. COURTHOPE MUNROE. He submitted that because one or two cases might work out the wrong way, the Council were not to be prevented from giving a preference which would hurt nobody and attract to their undertaking customers whose custom was beneficial. Only two persons would be hit by this scale of charges, and they would be hit because they had an abnormally good load.

MR. MARTELLI, in the absence of Mr. Courthope Munroe, continued the summing-up of the case for the defence. His Lordship remarking that the case was one of such importance that he desired all the assistance he could get from counsel. Mr. Martelli said where the charge was made under two different scales—two different prices—Sec. 19 was not contravened because the purchaser could come under which scale he pleased. The person against whom there must not be discrimination was a person taking a supply under precisely the same circumstances as some other persons. How could it be suggested that the supply of power corresponded with a supply for both power and light?

Counsel said he desired to deal shortly with the authorities that had been referred to.

His LORDSHIP said he did not desire to curtail counsel's argument in any way. He should be unable to give judgment during the present sitting as the case was one of such great importance that he must consider it. He could not help thinking that the matter must be thrashed out on much more elaborate evidence than he had heard from either side.

MR. MARTELLI agreed.

MR. JUSTICE SARGANT said that on the question of fact he supposed that the winding was a separate part of the business and was carried on in a separate part of the building, and therefore when the power stopped for winding machines light would also be stopped. The light in the winding department would not be required after the winding machinery had stopped?

Counsel agreed that that would be so.

Replying on the whole case, MR. ROMER said that he should assume that to the defendants the cost of energy was the same both for power and for light, for he thought the evidence proved that, or that the cost of the production of light was slightly higher than the cost of the production of power.

His LORDSHIP said that he did not understand that any difference in price was now insisted on. He took it that defendants were relying upon this additional demand for light as producing a levelling up.

MR. ROMER said then he might start off with this fact which was not disputed—that light cost, if anything, more than power. Then defendants charged 3d. per unit for light and only ½d. a unit for power, and yet they were contending that they were endeavouring to obtain customers for light in order to cheapen the cost of production. The fallacy that lay at the bottom of their argument was that they could supply a man more cheaply with light and power than than they could supply one man merely with light and and another with power. He could understand that argument if the machinery was working only in the daytime, because then the machinery that supplied the light at night could be used for supplying the power in the daytime, but immediately you got overstepping the contention failed, because you must have machinery sufficient for supplying the maximum load. When a man who was taking power came and said now also supply me with light, he was no different, so far as the cost of his supply was concerned, to a man who came and said supply me with light, I am not taking power. His submission was that the proposed distinction must be *ultra vires*.

His LORDSHIP reserved judgment until next sittings.

CHARING CROSS, WEST END & CITY ELECTRICITY SUPPLY CO., LTD., *v.* THE LONDON HYDRAULIC CO., LTD.

IN the Court of Appeal Lord Sumner, Lord Justice Kennedy and Mr. Justice Bray disposed of this case on the appeal of the defendant company from a judgment of Mr. Justice Scrutton. The question turned upon the reciprocal rights and obligations of companies having statutory powers to lay mains under the public streets. The plaintiff company supply electricity in the City of London, pursuant to the terms of a Provisional Order, and for the purposes of such supply they had laid electric mains in various streets. The defendant company, acting under statutory powers conferred upon them in 1884, had, in the same streets, laid certain hydraulic mains, which conveyed water at a pressure of 600 lb. to the sq. in. Their Act contained a provision stating that nothing should exempt them from, *inter alia*, actions for negligence or nuisance. Certain of the defendants' hydraulic mains burst and did damage to the plaintiffs' mains, for which the plaintiffs sought to recover. Their case was that the water either escaped from the mains through the defendants' negligence, or that, having escaped it became a nuisance. Defendants denied negligence, and said that in the absence of negligence they were not liable. Mr. Justice Scrutton held that the defendants, not being exempted from liability by their Act, and having brought their high-pressure water to the streets for their own profit, were bound to keep it there at their own risk, and were, therefore, liable for damage done by the bursting of their mains. Hence the present appeal.

Mr. Sankey, K.C., and Mr. F. Gover appeared for the appellants, and Mr. McCall, K.C., and Mr. C. B. Marriott for the respondents.

LORD SUMNER, giving judgment, said that both companies carried on undertakings for profit, for the purposes of which they obtained certain statutory permissions and powers, and also protections under private Acts of Parliament. The damage in respect of which the action was brought was actually sustained by the plaintiff company's cables in four streets—namely, Water Lane, Upper Thames Street, Cannon Street and St. Swithin's Lane. They were all streets in which both the mains of the defendants and the cables of the plaintiffs had been laid. The finding of the Judge in the Court below was that the mains having remained in safety for a considerable time, there were in 1912 subsidences and shiftings of the soil, leaving the mains unsupported in places, and that the weight and pressure of pipes, and the water within, probably assisted by the vibration of the heavy traffic and a sharp frost at the time, caused the respective fractures. Negligence having been negatived by the learned Judge, the question was whether, in the circumstances, the plaintiffs had suffered injury or an invasion of their rights by a nuisance on the part of the defendants. He thought that he might answer that question briefly by saying, in the words used by the Master of the Roles in Midwood and Co. *v.* Manchester Corporation, heard in 1905, that if this was not a nuisance, he did not know what would be one. The decision in that case was binding on this Court, and unless the two cases could be distinguished, no more was to be said. The Manchester Corporation were empowered to supply electrical energy in their district, and for that purpose to lay down mains, but it was a condition of their statutory powers that nothing therein contained should exonerate them from any indictmen action, or other proceeding for nuisance in the event of any nuisance being caused by them. One of their mains fused, and the bitumen, in which the mains was laid, in consequence became volatilised into an inflammable gas, which accumulated for some time and then exploded, causing a fire by which goods on the premises of Midwood & Co. were damaged. It was held that apart from any question of negligence, the Corporation were liable to Messrs. Midwood as for a nuisance. In his (Lord Sumner's) opinion, the facts of that case were indistinguishable from the facts of the present case. Further, he thought that this case was covered by the judgment of the House of Lords in the case of Rylands *v.* Fletcher, from the facts of which it was also indistinguishable. It was argued that the doctrine of Rylands *v.* Fletcher, was only applicable as between owners of adjacent closes, and that the principle there laid down depended on the rights attaching to the ownership of land; whereas here, it was said, instead of two adjacent owners of land there were two neighbouring owners of chattels not strictly adjacent. It was also said that the parties here were in the position of co-users of a highway, and that on that ground also the doctrine of Rylands *v.* Fletcher did not apply. He did not think that these distinctions were well founded. In his opinion the doctrine of Rylands *v.* Fletcher was not limited to adjacent owners of land, but extended to such a case as the present. No doubt that case was a case between adjacent owners, but the judgments showed no intention of confining the principle to the case of adjacent freeholders. The defendants, too, had relied on the fact that they came to the *locus in quo* first, and that the plaintiffs came afterwards; and they contended that the plaintiffs were therefore bound to take the place as they found it, one of the things which they found there being the defendants' mains. No doubt there were cases in which it was said that a person who complained of a nuisance had himself

gone to the nuisance. But the analogy between this case and those cases, was not made out unless it could be shown that it was the normal condition of mains like the defendants', that they should squirt out water from time to time. If the argument about taking a thing as one found it was to be applied, it ought to be assumed that these mains were sound. He therefore thought the contention of the defendants, based on the sequence of events, was illusory. It was not having water in the pipes, or subjecting the water to high pressure, that constituted the legal wrong; it was letting the water escape that was the legal wrong. He thought that Sec. 17 of the defendants' Act of 1884 must be read as meaning that nothing in that Act or their earlier Act of 1871 should exempt the company from liability for the nuisance caused by them. The appeal therefore failed.

Lord Justice Kennedy and Mr. Justice Bray concurred, and the appeal was accordingly dismissed, with costs.

Crompton & Co., Ltd.

(Scheme Sanctioned and Action Stayed.)

In the Chancery Division, Mr. Justice Warrington heard the petition of Crompton & Co., Ltd., electrical engineers, for the sanction of the Court to a scheme of reconstruction.

Mr. Younger, K.C., and Mr. H. E. Wright appeared for the company, and Mr. Clauson, K.C., and Mr. Carr for certain debenture-holders, who opposed the scheme.

Mr. Younger said this matter came before his Lordship once again in a different shape from that in which he dealt with it on the last occasion. The matter then came before his Lordship in the form of a motion in a debenture-holders' action, asking for the appointment of a Receiver and manager, on the ground that although the debentures said that a winding up was not to make the principal moneys payable, when it was a winding up with a view to reconstruction, they were, in fact, payable. His Lordship came to the conclusion on the construction of the debentures that whatever the parties meant they had not succeeded in giving effect to it, and he thought the case was one for the appointment of a Receiver. His Lordship, however, directed that the appointment was not to be made for six weeks, in order that an appeal might, if decided upon, be entered, and in order also that the scheme now before his Lordship should be considered. Both things had been done; an appeal had been entered, but was not to be brought in if the scheme was to become effective, and the scheme had been prepared and passed by a majority of the creditors. The only opposition came from Mr. Clauson's clients, who were the plaintiffs in the action.

Mr. Clauson said he would suggest a modification of the scheme to meet his clients' views, and if that modification was accepted, they would not oppose the scheme further. They desired a term inserted in the scheme that as regarded any debenture-holder who had not voted in favour of the scheme, and who at some period expressed his desire to have his debentures paid off, the company should pay them off.

Mr. Younger: I cannot assent to that; it is impossible.

Mr. Clauson said it was quite plain that if the debenture-holders insisted on their rights now, they should be paid off at par; but he would be satisfied if that were done at some reasonable period.

His Lordship: I have to say whether the scheme should be sanctioned, notwithstanding the opposition.

Mr. Younger said in 1913, the company not having been very successful in recent years, a scheme of reconstruction was prepared and propounded for the purpose of bringing in fresh capital to the company through the medium of shareholders. By the scheme the company was to go into voluntary liquidation, with the view of its transfer to a new company, which would issue debentures for £100,000 in exchange for the present debentures. The rate of interest on the debentures was to be increased from 5 to 5½ per cent. The scheme made the new company bound in respect of the debentures as if it were the old company, and it gave the debenture-holders a charge on the whole undertaking of the new company, and gave them all the security they had, and an additional security as well.

Mr. Clauson: I accept that statement as accurate.

Mr. Younger said a meeting of the debenture-holders was held, when there were present 149 holding £74,000. In favour of the resolution there were 14 debenture-holders present in person holding £8,550, and 121 present by proxy holding £51,850, altogether 135 holding £60,400. Against the scheme there were two persons in person holding £2,500, and 12 persons by proxy holding £10,800, altogether 14 holding £13,300. So they had something in excess of the statutory demand. There was a sum of £50,000 brought into the company and the evidence showed that the effect had been to considerably increase the business of the company, and profits largely in excess of the old were now being made. Counsel concluded by asking his Lordship to sanction the scheme and said the opposition to it was a technical one.

Mr. Clauson said the only point before his Lordship was whether a term should not be put into the scheme that the debenture-holders who wished to be paid off should be paid off. He submitted that that was a proper provision to be put in the scheme, and if his Lordship assented to that he would hear nothing further from him.

His Lordship said the rate of interest on the debentures was to be raised from 5 to 5½ per cent., and the position of the debenture-holders in the new company and its assets was substantially the same, subject to this, that fresh capital to the amount of £50,000 was raised by the new company. Some proportion of that had gone to pay debts and liabilities of the old company, but how much that was he did not exactly know, or by how much the debenture-holders' security had been increased, if at all, by the raising of that capital. The voting on the scheme resulted in a majority in favour, exceeding the statutory majority by about £6,000. In these circumstances ought he to sanction the scheme? It was said that he ought not to sanction it without inserting a provision that the plaintiffs in the debenture-holders' action should not be affected by it. What was proposed was a compromise in the strictest sense of the term, because the plaintiffs had an action against the old company for the realisation of their debentures, and the company had presented an appeal against the order he pronounced the other day for the appointment of a Receiver. There was something of a compromise there. But if it were not a compromise, it was an arrangement between the company and its creditors. In regard to the meetings, the statutory provisions had been complied with, and he had to satisfy himself that the arrangement was such that a man of business would reasonably approve. How was it possible for him to say that it was not? It seemed to him that although the arrangement was practically an arrangement which did take away somewhat from the strict rights of the creditors, it was his duty to sanction it. He therefore sanctioned the scheme.

Mr. Younger said they would now take an order staying all proceedings in Mr. Blair's action (the debenture-holders' action), paying his costs in that action and on this petition, and discharging the Receiver.

His Lordship made the order accordingly.

Osram Lamp Works, Ltd., *v.* The Gabriel Lamp Co. and George Davis.

In the Court of Appeal, before the Master of the Rolls, Lord Justice Buckley and Mr. Justice Channell, on April 7th, this case was heard upon the appeal of the plaintiffs from the order of Mr. Justice Eve in the Chancery Division.

The case came before the learned judge on a summons for further and better answers to two interrogatories. The matter was reported in our issue of March 6th, page 426.

At the conclusion of the arguments their Lordships allowed the appeal, holding that the plaintiffs were entitled to have the interrogatories in question answered.

War Office *v.* Kirkland & Capper and J. H. T. Woodd.

(*Continued from page* 616.)

Continuing the cross-examination of Mr. Patchell, Mr. Walter, K.C., said:—Supposing that a fuse blows, and you put in another fuse of the same size and find that blows again. What should you say to a system which we shall hear of later, of putting in a fuse stronger and stronger till something held?—It is not a wise method.

That indicates the fault by burning it out?—It might do, without injuring the wire in any other place.

In the course of further cross-examination, Witness said that the work was done under the 1903 rules; the rules were altered very slightly in 1907, and considerably altered in 1911.

We have reached a standard of perfection nowadays?—They are levelled up with a view of eliminating bad work such as we see on the table here.

At this stage the Solicitor-General referred to the question of damages, and said it seemed to him it would be impossible for the Judge to go into this matter and discuss the damages until they ascertained what was the measure of liability, if liability existed.

The Judge said this seemed to be very reasonable.

Mr. Walter said his submission would be that everything that was done here was expressly authorised by the War Office specification.

The Judge: So I understand. The possibility of your being wrong must be taken into consideration, and if you are wrong, then the question arises as to the amount of damage. I have an opinion that you two gentlemen would be much better advised to refer any question of damage to some electrical engineer in whom you both have confidence.

Counsel for all three parties agreed to this course.

Mr. Patchell, further cross-examined by Mr. Walter, said that earthing of the casing of conductors was not only to guard against electrolysis, but for safety as well.

You do not earth the conductors?—Yes; the middle wire of a three-wire system is also earthed. This was a three-wire system supplied by the Westminster Electric Co., with 400 volts across the outers. By the Board of Trade regulation they had to earth the neutral point in the station. He did not agree that practical experience always showed that any electrolysis that was going to develop generally developed in the first six months.

The Solicitor-General: With regard to those two bad circuits that you examined, was there anything in the wire or in the insulation that you saw consistent with there having been a fault in the flex and an excessive current passed through the conductors through an overstrong fuse?—No, I do not think so.

Further cross-examined by Mr. Walter, Witness agreed that there was something on the copper of these two particular circuits that was not present in the other circuits. The inside of the rubber in both cases was not "tacky," but it was slightly sticky on the inside in one case. It was not so sticky as he would expect if it had been overheated. The lead of the pieces cut out was in good order.

Subsequently the Solicitor-General called evidence to prove that Messrs. Bolding's men were constantly on the premises within the year after May 13th, 1907.

Mr. Solomon Elliott, a headmaster at the college since it was opened, said he recollected electricians being there within the 12 months working at the lights. There were two men; they had nothing to do with the Royal Engineers or the staff of the college.

Mr. Frederick D. Brewer, waiter at the college, also gave similar evidence.

The Solicitor-General said that this was the plaintiffs' case, and he handed in the answers to interrogatories that he had received.

Opening the case for the defendant Mr. Woodd, Mr. Shearman, K.C., said he would submit that there was no case at all against Mr. Woodd, and that, in view of the contractual relations between the parties, there was no evidence of neglect by Mr. Woodd as an architect, and negligence was the only case that was suggested here against Mr. Woodd. The action was originally launched by the War Office against Messrs. Kirkland & Capper, the engineers, and they added Mr. Woodd as a defendant as soon as they found that he would not give evidence against the engineers. Dealing with the precise terms of the War Office contract with Mr. Woodd, Mr. Shearman emphasised the point that the electrical work was to be placed in the hands of "responsible experts." It was said in the amended statement of claim that Kirkland and Capper were employed by the War Office through the defendant Woodd. The agreement between the parties, broadly, was this: that Mr. Woodd was to be responsible as architect for the building, and Messrs. Kirkland & Capper were engineers responsible for the engineering work. It was not Mr. Woodd's duty at all to supervise the electrical engineering work. He was an eminent architect whose speciality was work for hospitals. He had done a great deal of work for Guy's Hospital, and this lead-covered system buried in plaster had been installed there; he was told that there were 30 miles of wire there, and the system was fully satisfactory. Messrs. Kirkland & Capper were paid a commission of 5 per cent. to include their certifying—the contract between the War Office and Messrs. Bolding said that the persons to certify should be Kirkland & Capper. Mr. Woodd was doing the architect's work under this £100,000 contract on the 5 per cent. basis, and he was not to be paid any percentage on the electric light. If there was anything wrong here at all it was due to lack of careful workmanship; upon the documents no charge of professional negligence against Mr. Woodd could be maintained. He would satisfy the Court that the system *per se* was not in itself a negligent system; it required very careful laying, and evidence would be called to show that the system had been carried out elsewhere with perfect success. The only obligation Mr. Woodd owed was not to be negligent as architect. He had no responsibility as regarded the choice of the electric lighting system.

Mr. Walter, K.C., in opening the defence of Messrs. Kirkland and Capper, formally submitted that there was no case against his clients of professional negligence. Messrs. Kirkland & Capper were an extremely well-known firm of consulting electrical engineers. Mr. Kirkland had been in practice on his own account for some 25 years. His partner, Prof. Capper, who joined him in 1898, was Professor of Engineering at King's College. The duties of a consulting engineer were to prepare the specifications and drawings necessary for the carrying out of the contract, to prepare tenders, to advise his employers as to such tenders, to instruct the contractors whose tender had been accepted generally as to how the work was to be carried out, and to instruct the clerk of the works who would be personally present during the whole time as to the carrying-out of those works. He would require the contractors to submit to him for testing and examination any of the materials that they proposed to use, and he would periodically, while the work was in progress, visit the works and see that his instructions were generally being carried out. It was next part of his duty to adjust between the contractor and the clerk of the works any disputes that arose as to the materials, or as to the nature of the work, as to which the clerk of works was making a complaint, and it was his duty to make such tests as he regarded as necessary to see that his instructions had been carried out, and finally it was his duty to certify that the work had been carried out to his instructions and to his satisfaction. It was not the duty of a consulting engineer to live on the works, he was employed for consultation and not for superintendence; it was not his business to see the materials delivered on the site, it was not his duty to watch the execution of every piece of work, or to see that every workman was doing his work properly—all those duties devolved on the clerk of the works, and here there was an able clerk of the works who was fully instructed by Mr. Kirkland as to those portions of the work with which Mr. Kirkland was concerned, and which he would have to see properly carried out. He had not been called in the case, and he was the clerk of the works employed by the War Office, who signed every certificate in the case. The Court would hear that the most extreme care was taken to see that all this work was properly done.

Mr. Walter went on to say that there was no agreement with Kirkland & Capper; they were employed as consulting engineers on the basis of 5 per cent., and no other basis, and there was no written contract. The acts of negligence alleged were:—(1) Using lead-covered conductors buried in plaster without conduits; (2) buried in plaster without protection; (3) conductors that were carried over "rough walling and sharp corners, whereby the lead covering became cracked and broken." No evidence had been given as to that or to suggest that anything had happened in regard to that. In the alternative it was said:—"If the lead covering did not become cracked from the said cause, the defendants negligently allowed the contractors to put the conductors in with the lead covering already cracked and broken." That was no part of a consulting engineer's duty; that was for the clerk of the works. It was said in the further alternative that the defendants, in permitting the departure from the specification, negligently omitted to order the same as a deviation from the terms of the specification, so as to secure the plaintiff a deduction from the amount payable under the contract. That was based on the assumption that a system was ordered that was cheaper, whereas the Judge would hear it was dearer, and it was only after considerable influence had been brought to bear that the contractors were got to forgo their claim to be paid for the more expensive work than that which they specified for. It was also said that defendants "negligently allowed the laying by the contractors of the lead-covered conductors in an irregular manner without keeping or communicating to the defendants any correct record of the places where the same were laid," that was, plans. The contract did not provide for these plans, they were never prepared and were never asked for. The drawings asked for were supplied. As to the acts of alleged negligence, counsel submitted that there was not a shred of evidence to justify any of the claims, that this was an action that ought never to have been brought and that it was started without any technical advice from any competent person. Counsel proceeded to review at great length the history of the case, from the verbal employment of his clients to advise the War Office as consulting electrical engineers, and dealt in detail with the various duties that fell upon them. It was said that lead-covered conductors might be used in any situation provided the conductors were accessible, and might be run through walls or partitions or plaster for short lengths, for instance, "behind cornices or mouldings." That was to say, if they wanted to bring a circuit in at the door they could run it the whole way round the room under the plaster. Counsel contended that the use of lead-covered conductors was authorised wherever conduit could be used, and it was necessary for the engineer to take care that the wiring was so divided up by means of junction boxes or connection boxes that they could locate any fault that there was in the circuit. That was the whole object of accessibility. Mr. Walter proceeded to deal in detail with the schedules, to show that no defect had arisen from the system adopted here of lead in plaster. He contended that the other side were trying to mix up the duties of the clerk of the works and of the consulting engineer, and produced diaries to prove the constant attendances of Mr. Kirkland and his intimate supervision. As each section of the wire was laid, it was tested before the plaster was put up; after all the plaster was in, every separate section was tested to see that it was right at the time after it had been plastered. After the whole installation was put in, it was tested by Mr. Kirkland personally throughout the whole building, and every single thing was perfect. Then came the electric light company, and that company did not put in anything till they had themselves tested to see that the wires were in a condition to connect with their mains, that was to say that there were no earths and no short circuits. They tested not only from the earth to the mains but between the mains, and everything was found perfect. Then the mains were connected, and the system went on. That lighting was taken over in May, 1907, and there was a resident electrician in charge, who had not been called in the case. The year 1907-8 was the year of maintenance, during which the contractor had to make good anything that happened. There were new things put in by the contractors on the instructions of the War Office, as to which no communication of any kind was made to Mr. Kirkland. Mr. Walter passed to an exhaustive critical examination of the complaints, and explained at length the three-wire system. He said he would show that the system adopted was perfect. The defects were between the boxes and the lighting points, that was where the users of the system could do harm. Every fuse in the building was over-fused. His experts would say that in this case the whole trouble had been that for a period of two or three years up to 1909, when Mr. Kirk examined it, there had been no proper care taken of this installation at all. The defects were clearly defects at lighting points and nowhere else. Counsel went on to allege that the system had been abused, and the whole installation had been treated in "a monstrous way"; in one instance bell wire had been put in by the War Office. He would call past presidents of the Institution of Electrical Engineers, who would say that the system here was perfect, and it was nothing but gross misuse that had caused these defects—defects that were perfectly trifling, and could have been put right, if they had been looked after as soon as they occurred, without the smallest difficulty. After charging his clients with negligence, the War Office had put in a fresh installation of their own, with a new specification in the contract: they had discarded their own specification.

The Judge: You need not detail that at length. At present I am not satisfied that even supposing you were negligent, you were negligent to such an extent, or in such a way as would justify them in scrapping the whole system and putting in a new system of their own and charging you with the cost of it. But that is quite another thing from saying that there is no liability for any negligence.

Mr. Walter: Of course. If there is any negligence we are liable. I am going to show by the evidence that the most scrupulous care was taken, and that there was no negligence of any kind or description.

Mr. John Henry Townsend Woodd, the defendant, was then called. He said he was a Fellow of the Royal Institute of British Architects, and he had practised as an architect for about 30 years. He was architect to Guy's Hospital, and had had a wide experience in architecture for hospitals, laboratories, and buildings of that kind, as well as general experience. In February, 1903, Colonel Lake, of the War Office, asked him to call and put before him the preparation of a design for the Medical Staff College at

Millbank. Eventually he suggested Mr. Kirkland as an electrical supervising expert, as Mr. Kirkland was working with him at Guy's Hospital, where they had employed lead-covered wire similar to that at Millbank in a large nursing home and chemical laboratories. He would advocate the burying of the wires in every good building, as projections were unsightly. The system of burying lead-covered wire in plaster had been perfectly satisfactory at Guy's Hospital. In the last three years they had put in about 13 miles of it, *i.e.*, of conductors. With regard to the War Office contract, the sum relative to the architectural work was about £85,000, on which his commission was to be charged. The builders were Ashby & Horner, of Aldgate. They used Frazzi blocks both for the support of the floors and in a great many of the partitions between the rooms. The electric light tender was signed on January 2nd, 1906, and accepted by the War Office direct, and at that date a number of these Frazzi blocks were in position. These blocks were very light, very strong and partly sound-proof. On no consideration would he have allowed the blocks, when in position, to be chased. As to the electric light system, the buildings being well advanced, he and Mr. Kirkland had to consider what system would be the best to adopt to avoid chasing the Frazzi blocks, and in order to produce what he required, a flush surface, both in the laboratories and also in the college building. Many of the ceilings in the college buildings were rather elaborately ornamented, and he saw that it was impossible to have exposed wires on those, and they agreed, after due consideration, that it would be best to adopt the system of lead-covered wire buried in plaster that they had used successfully elsewhere. He did not know what the terms of the contract were between Messrs. Bolding and the War Office, or whether the system he was ordering was or was not a direction to vary the contract. Had he known that he could not do it in this way without varying the contract, he would have directed a variation. He thought no other system could have been adopted where the Frazzi blocks were in the ceiling, as the floors over the ceilings were solid concrete in almost every instance in both buildings. He thought it was not practicable to run behind the Frazzi blocks and drop wires through a hole bored in the Frazzi. There were 879 points altogether, of which 112 were in benches, where this system did not apply. That gave 767, of which 451 were in the college, and of these 335 went wholly or partially over Frazzi blocks; of those in the laboratories, 155 out of 316. He took no part in supervising the laying of the wires, and in his experience he had found no difficulty in their being laid properly by competent workmen. The clerk of the works in this case was the most excellent clerk of the works he had ever worked with. If he had the building to re-wire that day he would wire it in the same way. He took the view as against the view of the War Office that no blame attached to the consulting engineers, and as a result he had been made a defendant to the action.

In reply to cross-examination by the Solicitor-General, Mr. Woodd said he had not had professionally under his charge at any time the installation of any electric light system. He believed that at Guy's Hospital they had tried to chase the Frazzi blocks when in position to get water pipes through, but it was seldom done successfully. A man would probably break one block out of every five in chasing. He considered that he omitted nothing that could be construed as professional negligence against him, and by his reading of the documents he thought it was fully open to him to use the system that he did.

Re-examined by Mr. Shearman, Mr. Woodd said he had found that this was the first occasion on which in a large building they had used this particular Frazzi construction. As to the suggestion that tubing might have been run between the ceilings and the floors, all the floors were solid from the ceiling to the surface above, except in the roof, which was pierced. He did not give any emphatic direction that lead-covered wire should be used throughout; he only advised it as the best system, provided there was no objection in the mind of the engineers to adopting it.

Mr. Arthur Blomfield, a member of the firm of Sir Arthur Blomfield & Sons, Montague Place, Baker Street, W., architects, said he had heard that Mr. Woodd had declined to allow conductors to be run on the surface of the ceilings and partitions in connection with the laboratories and medical college, and, in his view, that was a reasonable and proper requirement. He thought that Mr. Woodd's decision not to allow the chasing of Frazzi blocks was a prudent and sensible decision to arrive at. He had seen the contract between the War Office and Mr. Woodd, and the power of variation. He had not seen the contract between the War Office and the contractor.

The Judge: Suppose the contract says that it should be in pipe wherever it is buried in plaster, and suppose you have not plaster that is thick enough to bury the pipe, would you consider it proper, as an architect, to vary the system in the contract under the variation clause?—I think, so far as I am concerned, I should not have done so without approaching my clients, but I do not think it was unprofessional to have taken that amount of discretion.

Answering Mr. Shearman, he believed there was no objection to the system of burying lead-covered conductors in plaster, but in these matters he would personally rely entirely on the advice and aid of an electrical engineer.

Cross-examined by the Solicitor-General: It was correct that in his experience in no case had the electrical engineer ever advised the laying of lead-covered conductors in plaster. The commonest system advised at the present day was the conduit system, the wires being laid in pipes.

The Solicitor-General: Assuming that the use of lead-covered conductors was either prohibited or strictly limited, do you think that a reasonably prudent architect, under Clause 8, would have ordered a departure from that system as a minor variation?—I am afraid I cannot regard it as reasonably prudent.

Re-examined by Mr. Shearman: Witness said he thought if an architect went down once a week to make inquiries of the clerk of the works it was very good. The clerk of the works as a rule was recommended by the architect and paid by the employer, but he was under the architect's orders.

Mr. K. D. Young, a Fellow of the Royal Institute of British Architects, said he had been in practice for 40 years, and was concerned with hospital architecture. He said it was prudent for an architect to consent to an electrical system where the wires were buried, covered with lead, in a building where the only other available means was laying them upon the surface. He thought there was nothing in the system adopted that made it unreasonable for the architect to adopt.

Cross-examined by Mr. Gordon Hewart: He considered that it was physically impossible to employ the conduit system at this college and laboratory, in the circumstances that had been explained. He agreed that conductors in barrel conduit were more accessible than lead-covered wires buried in plaster, and only knew of one case which he superintended, where lead-covered wires were buried in plaster. That was about 10 years ago.

Mr. Ernest James Brown, late president of the Institute of Builders, and chairman of the Frazzi Fireproof Construction Co., Ltd., said that Frazzi was a kind of terra cotta, and made of a particular alluvial deposit brought down by the River Po in Italy. He recollected his firm supplying Frazzi for the Royal Medical College at Millbank. The blocks could not be chased before put into position; they could be cut with a saw. They could be cut when in position, but much risk was incurred in doing it, as it would weaken the partition, weaken the joints, and in all probability, unless a man was very careful, he would cut right through the slab and smash the slab.

Cross-examined by Mr. Gordon Hewart, he thought it was possible to cut the blocks in position; it could be done in a very small piece, but all through a building it would never be done, and no self-respecting architect would ever allow it to be done. The opinion he had given was the result of practical experience.

This closed the case for Mr. Woodd.

Mr. Thomas Kirkland was then called. He said he was a consulting engineer, and had been in practice since 1891 on his own account, and since 1898 in partnership with Prof. Capper. Witness was the consulting engineer to Guy's Hospital, to the Brompton Hospital for Consumption, and to a large number of other institutions. At Guy's he designed and supervised the whole of the electric generating system, with an installation to start with of nearly 6,000 lighting points. He first used lead wire buried in plaster at Guy's in 1900; it was adopted to meet a special requirement, where they had walls that would not allow of being chased to any depth, and they had to devise a system to meet the arthitect's requirements of having the walls perfectly smooth. In 1900 the length of the installation was about a mile or two, and that had been continually extended. Sometimes they had used casing and iron tubing. He thought there were about 30 miles of lead-covered wire buried in plaster at Guy's, and the system was perfectly satisfactory. In regard to the Millbank buildings, he was asked by Mr. Woodd if he would act as consulting electrical engineer for that installation, and he consented, and he received the War Office specification in June, 1904. He prepared the contract and conditions under which the work would require to be done, which he called the specification at the end of the contract. He made himself fully acquainted with the terms of the War Office electric light specification, and he arrived at the conclusion that the conditions laid down warranted him in using lead-covered conductors buried in plaster, as Clause 13 had this condition: "The conductors are in all cases to be accessible to authorised persons."

What provision in using lead-covered wire did you make to comply with that clause?—According to my view of accessibility, there are two requirements to be satisfied; the first is that you should be able to get at the ends of the wires to test if they are all right or not, the second is that you should be able without undue trouble or expense to replace any damaged wire. I satisfied the first condition by putting in what his Lordship defined the other day as manholes at either end, so that they could be got at; then I adopted the principle I had adopted from the first start of my use of this wire, that it is of no use imagining when you bury wire that you want to get it out. You do not want to get it out. What you want to do is to be able to replace any of those wires, and the method of replacement is by cutting off the ends of the wires at these manholes, and then making a fresh chase to the point which you want to remove and inserting a new wire.

(To be continued.)

Tramway Rating Appeal.

The Court of Appeal has, by a majority, allowed the appeal by the Islington Assessment Committee from a decision of a Divisional Court making absolute a rule *nisi* which had been obtained at the instance of the L.C.C. for a mandamus addressed to the appellants calling upon them under Sec. 47 of the Valuation (Metropolis) Act, 1869, to appoint a valuer to make a provisional valuation list showing the reduction in the rateable value of the County Council electric tramways, situate in Islington, arising from the competition of motor-omnibuses. We shall refer to the matter in a later issue.

E

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

A Loading System for Metal Scrap.

An interesting system for loading metal scrap into boxes, recently brought out by Messrs. Steel, Peech & Tozer, Ltd., of Phœnix Special Steel Works, Sheffield, is illustrated in fig. 1, in side elevation. It will be seen that it consists in the use of an overhead travelling crane working in conjunction with a movable chute. The magnet of the crane is lowered into the scrap wagon, which stands on a line of rails at one side of the area over which the travelling crane operates. The magnet picks up a load of scrap, and the crane is then moved to bring the magnet over the scrap chute; the load is released, and the scrap is guided by the chute directly into the box or pan which has to be loaded. When the

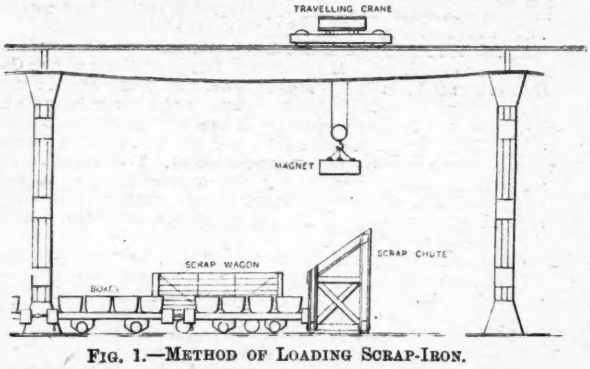


Fig. 1.—Method of Loading Scrap-Iron.

box is filled the magnet is lowered on the chute, and current is then switched on to the magnet, the crane is set in motion and the chute is moved over the next box or pan to be filled. No locomotive is required after the pans have been put into place, and the crane-driver is able to do the whole work of transference.

The magnet which is used for this class of work is a 52-in. or 72-in. size, according to the scrap to be lifted. By this method it is claimed that all the scrap handled is lifted by the magnets directly into the box, whereas in present methods of loading a good deal of the scrap lifted by the magnet, instead of going into the box, falls outside on the floor.

A Waistcoat-Pocket Wireless Detector.

The Ondophone, invented by a French engineer, M. H. Hurm, of Paris, is a wireless telegraph detector of strikingly small dimensions. The apparatus (fig. 2) only weighs 195 grammes, and is readily carried in a waistcoat pocket, though lending itself, on account of its great sensitiveness, to many applications in actual practice.

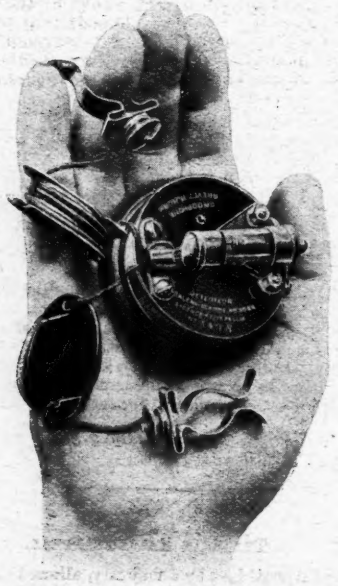


Fig. 2.—The Ondophone.

The extremely sensitive detector proper is designed on M. R. F Pellin's patented system, which is based on the use of a galena crystal, without any liquid or fragile parts, such as glass, &c.; it is worked without any battery, and has the advantage of being subject to no wear and tear, the crystal contact being practically invariable. Another factor increasing the sensitiveness of the apparatus is the direct connection of the detector with the receiver, and the separate arrangement of the incoming wires, which reduces the mutual induction of the latter to a minimum. The substantial design and accurate adjustment of the ondophone are likewise valuable aids to its sensitiveness.

The ondophone can be connected up to the circuit at a moment's notice; the connecting wires are each 2 m. in length, thus allowing of a distance of 4 m. between the earth connection and the antenna. Each wire carries a bobbin, on which it may be wound up partly or entirely as the case may be.

Since the point of the seeker coincides with the most active part of the detector crystal, the most sensitive spots are found in a minimum of time; the signals can be heard almost anywhere on the surface of the crystal, and the only thing required is to search for the point where the reproduction reaches a maximum intensity. As soon as this point has been found, the seeker is fitted with a protective hood, preventing any accidental displacement.

Earthing can be effected by means of any (unpainted) water or gas pipe. If no such pipe be available, a piece of metal gauze or a metal plate of several square decimetres should be buried in moist ground, one of the terminals of the ondophone being connected with a metal wire soldered to the plate. Another method consists in allowing one of the terminals to lie on moist ground, contact being made by putting the foot or any heavy object on it. When there is no proper earthing available in the neighbourhood of the apparatus, *e.g.*, in a telephone cabin devoid of gas lighting, it sometimes suffices to put the terminal on one of the fingers. This enabled the Eiffel Tower signals to be heard distinctly at Sables d'Olonne, *i.e.*, at 450 metres distance, though the apparatus was insulated by the carpet and floor, the second terminal being connected up to a telephone line.

In order to ensure a connection with the Eiffel Tower within a radius of 200 km. round Paris, any slightly insulated small metal piece can be used as antenna. The greater the distance from the transmitting station the better should, of course, be the insulation and the larger the antenna connected with the ondophone. In the case of any considerable distances, an aerial wire proper cannot be dispensed with, the received intensity of the signals being the higher as the aerial wire is longer, higher and better insulated. The conductor of any telephone or telegraph apparatus constitutes an excellent aerial wire, by means of which the Eiffel Tower signals can be perceived throughout the whole of France and part of the border countries.

"Plexsim" Griddle Plates.

Amongst the several new items on the Plexsim system placed on the market by Messrs. Simplex Conduits, Ltd., of Garrison Lane, Birmingham, attention may be drawn to a range of griddle plates. There is a ready demand for these, especially in the North; sizes are made suitable for the needs of both restaurants and domestic service. They are rectangular in shape, finished in black

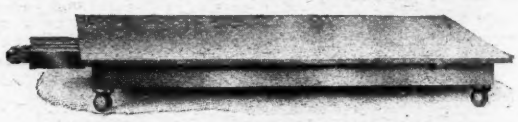


Fig. 3.—Simplex Electric Griddle Plate.

with a planed metal top; a useful size for the house is 16 in. long × 8 in. wide, loaded with 1,000 watts. Temperature regulation is provided for by the usual three-pin terminals; the plates are supported on insulating feet, and have a good general appearance. The largest size is 24 in. × 12 in., taking 2,500 watts at full load.

Benjamin Half-watt Lampholders and Reflectors.

We have received from the Benjamin Electric, Ltd., of 1A, Rosebery Avenue, E.C., particulars of their Goliath screw lampholders for half-watt lamps. These consist of a one-piece china

Fig. 4. Fig. 5.
Benjamin Lampholder and Reflector.

holder with copper screw contact and centre contact of spring phosphor-bronze to ensure constant contact with the lamp cap. All other conducting parts are heavy electro-coppered brass stampings. Open

terminals (fig. 4) are provided for situations where the holder is enclosed, and concealed terminals for exposed installations; either type may be provided with the Benjamin lamp grip, which is regarded as important for half-watt lamps of high candle-power.

The firm has also introduced an extensive and an intensive distribution type of steel reflector, fig. 5, in two sizes, for 300 and 500-watt lamps. These are of enamelled steel, fitted with the types of lampholder already mentioned, and giving ample ventilation and easy access to the terminals for wiring.

These reflectors are claimed to give efficient light distribution, and to shield the glare from the naked filament; they have been specially designed for factory and interior use.

Electro-Pneumatic Hammer.

Messrs. S. Wolf & Co., of 115, Southwark Street, S.E., have recently introduced a new electro-pneumatic hand hammer, which appears to possess advantages over the ordinary compressed-air hand hammer, in that being a self-contained unit it can be moved about to any required position and coupled to any available lighting or power circuit. It consists of a small motor-driven air compressor, using low air pressure, and a length of armoured hose connecting it to the hammer. The actual blows of the hammer are caused by the rapid alternate admission and withdrawal of air

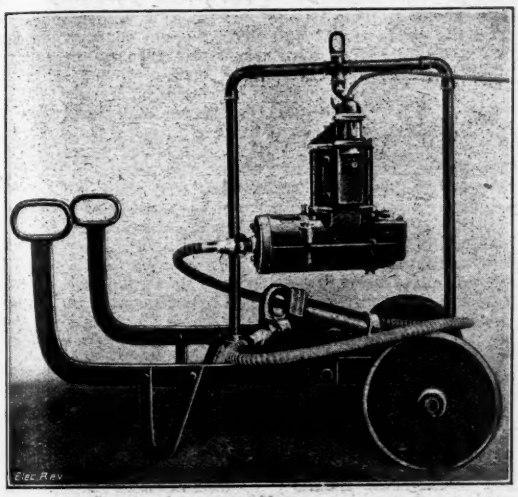


Fig. 6.—Electro-Pneumatic Hammer Outfit.

behind the piston which carries the hammer head, and the strength of these blows can be adjusted at will. As the pressure on the working side of the piston falls to atmospheric at the end of each stroke, the cycle of operations is bound to recommence automatically. The air pump is provided with an eyebolt for lifting purposes, and a light tripod or truck is provided to facilitate transport. The apparatus is built to standard throughout and is suitable for use in engineering works for cutting or riveting, and should be valuable for drilling in stone quarries. The motors are built for all standard voltages and for both continuous and alternating current.

An Electric Car Telephone.

Those who use motor-cars will know the difficulty, particularly in those types of car construction where the driver sits outside the enclosed body, of communicating with the driver when the car is under way. In some cars a speaking-tube has been installed, but this is a more or less unsatisfactory device.

In order to remedy this deficiency, a very neat form of car telephone has recently been brought out by the American Electric Co., of Chicago. It consists of a special transmitter with a convenient handle and a loud-speaking receiver, with a projector for attaching on either the right or left-hand side of the car, near the chauffeur. The receiver is furnished with a curved trumpet, which is said to have the effect of magnifying the sound very considerably, with the result that an order transmitted in quite an ordinary voice inside the car is heard distinctly by the driver under all conditions. A 6 or 8-volt battery is used, and the current consumption is very small.

Electricity in Fiery Mines.—The chief subject discussed at the resumed Conference of the South Wales Miners' Federation on April 7th was the use of electricity in fiery mines. The matter arose out of statements at the Senghenydd disaster inquiry, and the danger of the emission of sparks from cables was emphasised by Mr. T. Richards, M.P., general secretary of the Federation. Reports from various lodges were considered. There was a preponderance of opinion that the use of electricity as a motive power should be prohibited, and a resolution was carried asking the Labour members in Parliament to endeavour to secure the prohibition of electricity for motive power in fiery mines.

BUSINESS NOTES.

Cables for the Buenos Ayres Western Railway.—The electrification of the Buenos Ayres Western Railway Suburban System is probably the largest railway electrification scheme yet undertaken, and a few particulars of the cables will be of interest. The contract for supplying and laying the whole of the cables in connection with the undertaking has been secured by W. T. Henley's Telegraph Works Co., Ltd., which firm, it will be remembered, also secured a similar contract in connection with the electrification of the suburban lines of the Central Argentine Railway, the cables for this latter undertaking being now in course of installation. The Buenos Ayres Western Railway system will be operated at a pressure of 800 volts direct current. Energy will be generated at 2,500 volts, 25 complete cycles per second, and transformed to 20,000 volts by means of three single-phase step-up transformers connected directly to the terminals of each generator. This will then be transmitted to five sub-stations, the feeders to two sub-stations being run in duplicate. These sub-stations will be equipped with rotary converters for transforming the three-phase current to continuous current at the pressure of 800 volts, and from there connection will be made to the conductor rails. The principal cable item is one of approximately 116,000 m. of '10 sq. in. three core, split conductor, paper-insulated, lead-covered, and steel-wire armoured cable, which is to be used for feeders at the working pressure of 20,000 volts. This cable will be tested after 24 hours' immersion in water up to 50,000 volts, and a sample piece cut from any drum selected by the consulting engineers, is to withstand a test pressure of 100,000 volts. It will be laid direct in the ground at a depth of 1 m., further protection from mechanical damage being afforded by 2-in. creosoted boards being placed over the cables. At cross culverts and level crossings the cables will be drawn through cast-iron pipes, and where they run across bridges they will be hung on racks and protected from the sun's rays by sheet-iron. All joints will be of the vacuum type in gun-metal sleeves, similar to those adopted for the Central Argentine Railway cable. The track cable consists of about 17,000 metres of single-core paper-insulated cable, part of which will be lead-covered and single-wire armoured, and part sheathed with vulcanised bitumen, taped, braided and laid solid in fibre troughing. This track cable will, of course, feed the conductor rails and connect across breaks in the rails at level crossings, junctions, &c. The contract also includes the supplying and laying of about 58,000 metres of dry core, lead-covered and wire-armoured telephone cable, and, of course, the necessary terminal boxes, pillars, telephone apparatus and accessories, of which a very large quantity will be wanted. We understand that this is the largest contract that has ever been placed for any power cable installation, and following as it does in the wake of the Central Argentine Railway contract secured by the same firm, which at the time it was placed was a record contract, enables Henley's to feel proud of themselves as suppliers of extra-high-tension electric cables. Moreover, the portion of the work that has been put in hand by the railway company represents a part only of the complete scheme, which is divided into two sections—Section A, of which the contract under notice consists, being the larger of the two. If the railway company eventually decide to carry out the complete scheme, the value of the contract will be very considerably enhanced. The work is to be completed in 16 months, and it will call for the services of a large number of engineers, jointers, &c. Messrs. Livesey, Son & Henderson and Messrs. Merz & McLellan are the consulting engineers for the complete scheme.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—New Mazda automobile lamp folder (No. 2,342 C) of eight pages with space left for printing in the names of firms who require numbers for distribution. Small illustrations and tabulated prices are given of headlight, sidelight, tail and dashlight, steering-pillar light lamps and festoon and tubular lamps for interior lighting. Dimensioned diagrams show the measurements of the lamps and bulbs.

Mr. E. H. Thew, 2-8, Dean Street, Newcastle-on-Tyne.—Specimens of ivorine and metal labels for machinery.

Messrs. David Rowell & Co., Ltd., 33, Old Queen Street, Westminster, S.W.—Catalogue D58 of 32 pages, giving illustrated descriptive matter relating to iron fencing, gates, iron buildings, stairs and bridges.

Messrs. Alfred Herbert, Ltd., Coventry.—The April number of the firm's *Monthly Review* of modern machine shop practice contains well-illustrated articles on a number of subjects, and a monthly stock list. Twenty-four-page illustrated list of capstan lathes, chucks and tools.

Sterling Telephone and Electric Co., Ltd., 210-212, Tottenham Court Road, London, W.—Publication No. 223, shows illustrations of their Equipose telephone arm used in various positions, and states prices of same.

Messrs. Oliver, Clark & Co., 41, Gerrard Street, Shaftesbury Avenue, London, W.—24-page catalogue showing a collection of electric lamp and candle shades in silk, parchment and paper, also the "Verilite" candles. Prices are quoted.

Messrs. Gent & Co., Ltd., Faraday Works, Leicester.—16-page booklet, containing an illustrated description of their "Tangent" system of shaft signalling apparatus, which does not employ stepping or ratchet mechanism in its operation. It provides a check on the signal sent, and a mistake made by the sender is at once apparent to the engineman. The number of the signal shows

at the first knock of bell, any signal sent, automatically extinguishes any previous one, and luminous indication of the levels, as well as of the signal itself, can be provided.

The General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—The firm's Osram lamp department have issued a handy blotter pad or book, consisting entirely of blotting paper, alternate pages bearing an illustrated advertisement of Osram wire-drawn lamps. Anyone in the trade can have one of these blotters on application.

Messrs. L. Andrew & Co., Whitworth Street West, Manchester.—Price list of india-rubber, canvas, and asbestos goods.

Bankruptcy Proceedings.—Morris Zains, described as an electrical engineer and tobacconist, of 98 and 105, Wardour Street, and 26, Dean Street, Soho.—An application for an order of discharge was made on Tuesday last week to Mr. Registrar Linklater, at the London Bankruptcy Court.

Mr. Egerton S. Grey, Official Receiver, reported that the bankrupt failed in October, 1910, with liabilities of £304, and no assets. A Russian Jew by birth, he came to this country in 1890 with £20 in his pocket, and was for some years employed in the cigarette trade. In 1900 he purchased for £130 a tobacconist's business in Wardour Street, and, two years later, he started business in the same street as an electrical and incandescent fittings dealer. He attributed his insolvency to liability under a judgment for £88 and costs in an action brought by the petitioning creditor for the return of balance of moneys handed to him (bankrupt) upon his consenting to stand bail for the creditor when arrested on a charge of receiving stolen property. As offences, the Official Receiver reported (1) insufficiency of assets to equal 10s. in the £ on the amount of the unsecured liabilities; (2) imperfect book-keeping; (3) trading with knowledge of insolvency.

His Honour made an order for the discharge to be granted upon payment of £30 within one month, or, in the alternative, a further suspension of two years.

J. G. S. Cunnington & H. P. Allison (Laing, Wharton and Cunnington), electrical engineers and contractors, 7, Great Newport Street, W.C.—Trustee (Mr. A. Page, 28, King Street, E.C.), released March 2nd.

Frederick Thomas Hewitt, of 28, Avenue Road, Bradford, formerly carrying on business in partnership as electrical engineer under the style of "Foyard & Hewitt," in Victoria Chambers, Bradford, and now a commercial traveller for the same firm, was examined at the Bradford Bankruptcy Court last week. He admitted liabilities of £130, with no assets except £13 12s. 6d. paid to the solicitor for filing his petition. He and his partner were formerly clerks in the employ of the Phœnix Dynamo Co., and when he left to go into business with Mr. Foyard, he had no capital. He left the partnership in December, 1910, because capital was needed, and he had none. For 18 months after that he sold electrical fittings on his own account, and after that he had acted as a traveller for his former partner at 30s. a week salary with travelling expenses. The examination was closed.

Tom Murray Woodcock, electrical engineer, 64, Holly Street, Sheffield, Yorks.—The first meeting of creditors herein was held on April 8th, at the Official Receiver's offices, Figtree Lane, Sheffield, when the liabilities were put at £209 and assets at £54, leaving a deficiency of £155. The failure was attributed to lack of capital, loss on contracts, and heavy business expenses. The Official Receiver remains trustee.

W. H. Pease, electrical engineer, Royal Hotel Shops, Scarborough, and 19-20, Baxter Gate, Doncaster. Receiving order made April 9th on debtor's own petition.

Trade Announcements.—To meet increasing business Messrs. F. Parkinson & Co. have erected new premises, comprising offices, works and stores, at Wells Works, Guiseley, Leeds, and henceforth all correspondence should be addressed there. Telephone numbers: Leeds Area "35 Guiseley"; Bradford Area "34 Guiseley." Telegrams: "Parkinson 35 Guiseley."

Messrs. J. F. Leach & Co., electrical engineers, 5, Market Street, Manchester, invite manufacturers to forward catalogues and lists.

Messrs. A. H. Faulkner & Co., electrical contractors, 8, Market Place, Manchester, have taken into partnership Mr. J. R. Chadbourne, late engineering sales representative in the Manchester district for Messrs. Richard Hornsby & Sons, Ltd. The business will in future be carried on at the same address under the name of Faulkner, Chadbourne & Co. Firms are invited to forward trade lists.

Messrs. Rose Bros., of London, are holding an exhibition of electrical novelties (pocket and police lamps, advertising novelties, massage, cinematograph and other apparatus) at the Victoria Hotel, Manchester, from April 20th to 24th.

Lead.—In their latest report, Messrs. James Forster and Co. state:—"The influence of the recent selling of American native lead still hangs over this market. Dealers are apprehensive of a renewal of same, and the comparative prices in New York and here are too close to be comfortable. The difference is certainly not sufficient to protect us if the position on the other side does not improve. Consumption continues very heavy, particularly in the electrical trades and, although arrivals for the three months ending March 31st are considerably heavier than for the like period in 1912 and 1913, there is still no surplus lead about."

Cranes at the County Hall.—We understand that the three motors installed on a locomotive crane, which runs along the river front of the County Hall, referred to in our issue of March 27th, were supplied by Messrs. Crompton & Co., Ltd., to the order of Messrs. Butters Bros., the makers of the crane.

Private Arrangements.—T. W. Vaughan & Co., Ltd., 22, Cross Street, Islington, London, N., electrical engineers, &c.—The creditors interested herein were called together last week at the Institute of Incorporated Accountants, Gresham Street, E.C., when a statement of affairs was presented, which had been prepared by Messrs. Greenhalgh, Sharp & Co., I.A., of 16, King Street, Cheapside, E.C. The statement of affairs disclosed liabilities of £3,484, of which £2,940 was due to unsecured creditors, and £551 to the debenture-holder. The assets were estimated to realise £2,841, less £133 for preferential claims, leaving net assets of £2,708. Those assets were not sufficient to meet the claims of the debenture-holder, and a deficiency was thus disclosed of £3,484. Mr. J. K. Garioch, the liquidator of the company, stated that Mr. W. Ros Sharp had been appointed to act as Receiver for the debenture-holders. The liquidator further stated that the company was incorporated on March 15th, 1911, with a nominal capital of £5,000 divided into 2,000 ordinary shares of £1 each, and 3,000 6 per cent. cumulative preference shares of £1 each. The vendors were Thomas William Vaughan and Walter Grey Smail, and the first directors of the company were Thomas William Vaughan and Mason Kidner. The vendors were allotted 1,000 ordinary shares each in consideration of goodwill and purchase of business. In May, 1912, Mr. F. C. Stark became a director of the company and purchased 1,000 ordinary shares and 490 preference shares, and on the same date took up 1,000 preference shares for cash. In July, 1912, it was found necessary to find further capital, and Mr. Stark guaranteed an overdraft of £500 at the bank, and again at the end of September the same conditions arose, and Mr. Stark guaranteed a further overdraft of £500. In April, 1913, further money was required, and Mr. Stark advanced further amounts aggregating £800. On June 6th the company created a charge on the whole of the assets in the form of a debenture for £3,500 in favour of Mr. F. C. Stark, to cover the amounts already advanced, and the balance of the amount of the debenture was subsequently paid to the company by Mr. Stark. During the year ended March, 1912, the sales were £8,580, with a gross profit of £1,694, and after allowing for all outgoings and depreciation there was a net loss of £557. In the following 12 months the sales were £14.151, the gross profit £2,478, and there was a net loss of £681. For the year to March 14th last the sales were £11,502, and there was a net loss of £2,566. Replying to questions, Mr. Garioch said that when the company was formed the goodwill was valued at £1,000 odd. In January of last year it was reported to the board that the company had entered into a contract with the London Opera House, which had resulted in a loss. In view, however, of the advertisement which the company had received through that work, it was decided to increase the goodwill by £1,800 odd. Dissatisfaction was expressed by the creditors present, and it was decided that the meeting should be adjourned. The following are creditors:—

Sloan Electrical Co.	£277	Albion Iron and Wirework Co.	£67
Siemens Bros. Dynamo Works	222	Rowson, Drew & Clydesdale	37
Brit. Westinghouse Electric Co.	154	Bullivant & Co.	29
Mellows & Co., Ltd.	150	Cope, Allman & Co.	28
London Elec. Warehouse (?) Co.	141	Campbell, Macmaster & Co.	28
Igranic Electric Co.	129	Senier, T. W., & Co.	26
Cresswells, Ltd.	120	Hare, F. B., & Co.	24
Thames Bank Iron Co.	114	Russell, Jas., & Sons	24
Walsall Hardware Mfg. Co.	102	Krupka & Jacoby	23
Union Electric Co.	95	Gornal, W.	19
London Com. Elec. Stores	83	Wilkins, N. W., & Sons	21
National Radiator Co.	76	Winn, C., & Co.	21
Newton Chambers & Co.	69	Bisby, F., & Co.	20
Baldwins, Ltd.	65	Hunt & Mitton	20
Brotherton Tubes and Conduits, Ltd.	62	Walker's Perfection Fire Co.	20
McCrea & Sons	58	British Uralite Co. (1908)	19
Spencer, J. E. H.	50	Wilson-Wolf Eng. Co.	18
Foster Engineering Co.	47	Hudson, W. A.	18
Bennett, E., & Son	47	McGaw & Co., Ltd.	18
Kemp, John, & Co.	39	Masham, J., & Sons	17
		Potter & Co.	16
		and 97 creditors for smaller sums.	

Broken Hill Mines.—At the annual meeting of the Broken Hill South Co. held at Melbourne in February, Mr. M. R. Greene, chairman, said that to economically work the southern section of the mine and to enable increased quantities of ore to be dealt with, the directors had decided to install an electrically operated plant at No. 2, No. 4 and No. 5 shafts. All ore at present came up No. 1 shaft. The southern ore would be brought up No. 4 shaft, where it would be necessary to erect storage, crushing and transit facilities to handle this material. The work was one of some magnitude, and would also necessitate a rearrangement of their tramways, &c. They would make their own sulphuric acid, and storage facilities were needed for this purpose.

Electric Lighting in India.—The problem of lighting in India has been solved in many places by employing self-contained electric generating sets manufactured by the Aster Engineering Co. (1913), Ltd., of Wembley. It is stated that there are over a hundred of these Aster sets, of varying capacities, in use in different parts of India. They are installed in the Government houses at Ranchi, Chittagong, and Bankipore, in a number of clubs, in various hospitals, in the bungalows of officials of the Assam-Bengal and Eastern Bengal State Railways, as well as in the palaces of a large number of native gentlemen.

Meter Contracts.—Messrs. Chamberlain & Hookham, Ltd., have received the following contracts for meters for the ensuing year:—West Hartlepool, Pembroke, Halifax, Barrow, Mansfield, Newport and Belfast.

Liquidation.—The Argentine Electrolytic Syndicate, Ltd.—This company is winding up voluntarily with Mr. R. E. Clarke, of 17, Albion Street, Hanley, as liquidator. A meeting of creditors is called for April 23rd.

Social Evenings.—The members of the staff of the British Westinghouse Electric and Manufacturing Co., Ltd., connected with the supply department, chief office and stores, at Long Millgate, Manchester, held a smoking concert on April 3rd, at the Douglas Hotel, Manchester. This very successful social and musical evening was held to commemorate the trading in the supply department for the year 1913. Mr. J. Gibson, manager of the department, was in the chair, and he congratulated the staff generally on making the supply department, which has only been in existence a few years, into a profit-making business. He said that the outlook for the present year was entirely favourable, and that if the staff worked in co-operation and harmoniously together as they had done in the past there was no doubt that in 12 months' time he would be able to report still better results. Social evenings of this kind tended to "Rub off the corners" and promote good feeling and comradeship throughout the staff. Amongst others who contributed to the evening's entertainment may be mentioned:—Messrs. A. Pougher, pianoforte solos; W. H. Brown, baritone; Messrs. Hill and McGrath, Japanese fiddle duets; T. Clough, elocutionist; H. McGrath, baritone; E. Hunt, comedian; D. Elliott, comedian; W. S. Hayes, tenor; G. Ellam, bass; O. C. Oakley, baritone; A. Brignal, comedian; C. Thornley, comedian; and J. F. Cagney, humourist. We understand that the event is practically certain to be repeated annually in future.

Messrs. Elliott Bros., of Century Works, Lewisham, and Westminster, held their annual social on Saturday, 4th inst., at the Blackheath Concert Hall, over 700 employés and friends being present. An excellent entertainment was provided for the first part by the "Magpie Pierrots," the evening concluding with the play, "The Private Secretary," which was admirably performed. Refreshments were served in the interval, during which the Century Works Orchestra provided a capital programme of music. The company present included Mr. W. O. Smith and Mr. G. K. B Elphinstone, the heads of the firm.

LIGHTING and POWER NOTES.

Australia.—The gross revenue of the Melbourne municipal electricity department for the year ended December 31st, 1913, was £150,355, as compared with £130,276 in the preceding year. The expenditure amounted to £74,075, and the profit to £20,824. The E.L. Committee is of opinion that the present overhead mains should be placed underground, and has set apart £3,000 for the extension of the underground system.

Aylesbury.—Year's Working.—The U.D.C. has adopted a report by the resident engineer on the working of the electricity undertaking during the first year, which shows an output of 231,660 units, revenue £2,131, and expenditure, at 1·03d. per unit, £994. The substitution of gas by electricity for public lighting will effect a saving of £307, and after meeting the interest and sinking fund on a capital outlay of £21,331, there is an estimated surplus of £91 available for contingencies above the 2½ per cent. already provided.

Belfast.—Proposed Battery.—The City electrical engineer has reported that in December next the normal load on the generating station will necessitate the use of all the continuous-current machinery for both traction and lighting simultaneously, with the exception of one of the large units. If this failed there would be no spare plant, and he advised the Electrical Committee that the tramway service might be curtailed in favour of the lighting, which was compulsory, or the capacity of the station might be increased by adding a storage battery. An approximate estimate for a 1,000-kw. battery with boosters and switchgear, was £10,800, and £1,000 for new buildings. The Committee strongly recommended the latter proposal to the Corporation, but it decided to refer the matter back to the Committee for a report on the capacity of the present generating station. The question of the repairs of the tramway track, said to cost about £16,000 per annum, was referred back to the same Committee.

Braintree.—E.L. Scheme.—A Committee of the U.D.C., which had been advised by Mr. H. P. Girling, of Maldon, has reported that the cost of the proposed E.L. scheme would be from £9,000 to £14,000, including provision for free wiring and a plant capable of supplying Bocking. The Council decided to have a detailed report prepared by Mr. Girling, who would canvass the district.

Canada.—Hydro-Electric Report.—The annual report of the Ontario Power Commissioners shows a capital expenditure to the end of 1913 of $5,915,000, advanced by the provincial treasury at the rate of 4 per cent. interest. The total revenue was $2,611,918, as against $1,617,674 in 1912, and the surplus $620,875, as against $240,506. Allowing $230,480 as a depreciation charge, the net profit was $390,395. The total plant value of the municipalities is $9,196,483, and 45 municipalities are connected to the system. The progress can be gathered from the fact that in 1912 there were 33,568 lighting and 1,399 power consumers, while in 1913 the numbers were 63,157 and 2,532 respectively. The gross surplus invested in plant extension amounts to $861,381, depreciation reserve to $410,327, and net surplus so far to $451,054.

Representatives of Messrs. Smith, Kerry & Chace, of Toronto are inspecting the Athabasca River at Grand Rapids, with a view to the erection of a hydro-electric plant, estimated to cost from five to ten million dollars. It is proposed to transmit the power developed to Edmonton, which is 175 miles away.

The Toronto Hydro-Electric Commission is investigating the Interurban Electric Co.'s undertaking within Toronto, with a view to the purchase of the same.

Colchester.—The electrical equipment at Severalls Asylum (of the Essex C.C.) will entail a total expenditure of £15,609, instead of £13,480 as previously estimated.

Dartford.—Bulk Supply Proposals.—Mr. John F. C. Snell has advised the Council to proceed with the proposal to supply electricity to Crayford, at an estimated cost of £15,000, and to supply power to the West Kent Power Co. for Messrs. Vickers' and Messrs. Richards' flour mills, at £4 5s. per kw., plus 0·3d. per unit. The Council has decided to consider the report in Committee.

Dover.—Street Lighting.—The T.C. has decided to replace 257 gas lamps with 239 electric lamps, at a capital outlay of £1,600. The annual cost of the 257 gas lamps is £925, and E.L. will cost £846, an annual saving of £79.

At the Royal Hippodrome, which spends some £300 a year for electricity, it is intended to put down a private plant, and the borough electrical engineer is to advise the Council what will be a reasonable charge for a supply in the daytime, and also as a stand-by.

Dundalk.—Proposed Loan.—The U.D.C. has decided to apply for a loan of £20,000 in connection with the proposed electrical installation at the works of the Great Northern Railway Co. in that town.

Dundee.—Mr. J. W. Napier, engineer and manager of Alloa Gas and Electricity Departments, has reported on the proposed E.L. at Newport and Wormit to the effect that "the price of gas in Newport and Wormit is very reasonable, and unless there is reliable information before the T.C. that the electric light would be largely taken advantage of, the Council would not be justified in considering an E.L. scheme."

Ellon.—E.L. Scheme.—The T.C. has now decided in favour of an E.L. scheme. Guarantees for 1,300 lights have been secured, and the site of the present gas works is to be transferred to the undertaker for the erection of a power station.

Farnworth.—Bulk Supply.—The U.D.C. has sealed an agreement with the Lancs. E.P. Co. for a further supply of electricity in bulk, and is to install additional plant, including a 500-kw. rotary converter, at its works.

Failsworth.—Street Lighting.—The question of lighting part of the main road by electricity has been referred to the Lighting Sub-Committee for further consideration.

Gravesend.—Loans; Street Lighting, &c.—The favourable tenders received for new plant have enabled the T.C. to reduce the loan applied for from £13,600 to £12,500.

The electrical engineer has been instructed to convert the lighting of Darnley Street and Cobham Street from gas to electricity.

Mr. P. M. Crosthwaite, on April 7th, held an inquiry into the Council's application for a loan of £12,500, and the only opposition was by one or two members of the Council and Sir Julian Hayes, on the ground that the expenditure was unnecessary.

Grimsby.—We have received from Mr. W. A. Vignoles, the borough electrical engineer, a copy of the third edition of his "Electricity Consumers' Guide." In addition to a good deal of general information bearing on supply arrangements, examples of the cost of wiring premises and annual cost of electricity are given; useful suggestions are also given in regard to wiring, lighting, heating, cooking, &c.

Hazel Grove.—Proposed E.L.—The U.D.C. has confirmed an agreement with Messrs. Lomax, Kendal & Co. to take a canvass to ascertain probable consumers of electricity.

Hereford.—Proposed Loan.—The T.C. is applying for a loan of £1,500 for electricity mains, services, &c.

Hoyland.—E.L. Scheme.—The U.D.C. has instructed Mr. Barker, electrical engineer of Barnsley, to prepare plans of proposed mains, and also an estimate of the cost of a generating station, with a view to the Council generating and supplying electricity within its area.

Langholm.—Proposed E.L.—The T.C. has remitted to a committee to report as to the introduction of electric light.

Lincoln.—Rate Relief.—The T.C. has decided to allocate £1,500 from the electricity and tramway profits to the relief of the rates.

London.—Lambeth.—Infirmary Lighting.—The Building Committee has reported that the South London Electric Supply Corporation has offered, in connection with the lighting of the children's infirmary lodge and isolation block at Norwood, to lay the mains, free of cost to the Guardians, and to supply electricity at 3d. per unit for lighting and 1d. per unit for power, for five years. The Committee was of opinion that this was a favourable opportunity to install electricity in these institutions, and to make a comparison between gas and electricity; and, furthermore, considered that electricity was cleaner and more healthy. The Committee recommended that the offer be accepted, and that tenders for the wiring and fittings in the institution be invited.

Although the board recently approved of an estimate of the South Metropolitan Gas Co. for the installation of gas fittings in the southern wing of the infirmary, the superintendent, in view of the discussion by the Committee, withheld the order for the time being. An offer of the Gas Co. to re-model the whole of the fittings in the infirmary for £35 was referred to the Committee for consideration.

Electricity Supply of London.—Owing to the hostility of the engineers of certain of the London electricity companies, it is the intention, says the *Financial News*, of the bankers supporting the London Electric Supply Bill to withdraw it for the present session of Parliament, the prospect of any agreement between the parties concerned being remote.

Messrs. Merz & McLellan's report to the L.C.C. on the subject of the future of London's electricity supply was issued on Wednesday last. Their conclusion is that, whatever form of control be adopted, a new undertaking should be established to carry out the necessary changes leading to the ultimate amalgamation of the existing undertakings, as far as possible without compulsory powers. They regard the concentration of generating plant on sites down the river as the correct policy, and advise that a high-pressure three-phase primary distribution system at 50 cycles per second be standardised for London as soon as possible. They consider that the policy of concentration, after disposing of the existing plant, would result in a net saving of about £170,000 a year; the initial capital outlay required would be six or seven millions sterling. The idea of retaining and extending even two or three of the best existing stations on the river banks is rejected as inadmissible, and that of generation at the coalfields is also dismissed from consideration at present. Further particulars will be given in our next issue.

The L.C.C. has been recommended by its Finance Committee to sanction the borrowing of £10,087, as to mains, £7,055; machinery, £1,292; services, £1,040; and meters, £125, by the Southwark B.C. for electricity purposes. Also the borrowing by the Woolwich B.C. of £15,000, as to buildings, £6,000; and machinery, £9,000; in connection with the extension of its electricity undertaking.

Lowestoft.—Loan Sanction.—The T.C. has received L.G.B. sanction to a loan of £950 for meters, repayable in five years.

Malvern.—The U.D.C. has resolved not to entertain the offer of a supply of electricity in bulk from Worcester Corporation. It also decided, at an estimated expenditure of £1,500, to install additional plant at the electricity works.

Mold.—E.L. Scheme.—Mr. Leigh, of Northwich, has submitted to the T.C. a report on the suggested E.L. installation for the town.

Newcastle (Co. Down).—Last week the chairman of the U.D.C. laid the foundation stone of a power station in connection with the E.L. scheme for the town. The Irish Towns E.L. and Power Co. is to provide 100 50-c.p. lamps, 30 25-c.p. lamps and three lamps of 300 c.p. each.

Normanton.—Proposed E.L.—The U.D.C. has been recommended to promote an E.L. order, and to appoint a sub-committee to make the necessary arrangements.

Passage West (Co. Cork).—E.L. Scheme.—It is understood that the scheme for the E.L. of Passage West, Glembrook and Monkstown will be worked in connection with the electrical plant at Passage Docks. The number of public lamps to be erected is 42. The Cork R.D.C has provisionally approved of the scheme, which will cost about £3,000.

Rathkeale (Co. Limerick).—E.L. Scheme.—Steps are being taken to provide an E.L. undertaking in the town, and promises to take a supply have been received.

Ruthin.—Prov. Order.—The B. of T. has granted a prov. order for the installation of electric light in the borough.

South Shields.—The Council has decided to carry out an extension to the sea front lighting, and is installing 10 Metroflam magazine arc lamps (75 hours' burning).

Saddleworth.—E.L. Proposal.—The first meeting of the newly-formed Electricity Committee has discussed the proposed electricity scheme. Several members thought there was no chance of a scheme of production succeeding, and the best thing would be to obtain a supply elsewhere.

The opinion was expressed that there would be a better chance of a lighting scheme succeeding if the Council could buy cheaply in bulk from Stalybridge or Oldham, or both. The meeting was adjourned in order that inquiries might be made from these places.

Springhead.—Proposed E.L.—The U.D.C. has appointed a deputation to inquire on what terms the Oldham Corporation will supply electricity to Springhead.

Sunbury.—Prov. Order.—The D.C. has consented to the granting of the proposed Feltham and District E.L. Order. At a B. of T. inquiry, the promoters intimated that as soon as an order was granted, a company would be formed.

Tasmania.—The gross revenue of the Launceston E.L. and Power Department for the year ended July 31st, 1913, was £21,666, and the working expenses amounted to £7,924. The net revenue amounted to £13,619, and the surplus to £5,676, as compared with £4,088 in the previous year.—*Australian Mining Standard.*

Torpoint.—Public Lighting.—The U.D.C. has sealed an agreement with the new E.L. Co. for electric lighting in the town.

Torquay.—Proposed Loan.—The T.C. has decided to apply for sanction to a loan of £16,000 for additional plant at the electricity works. Mr. Salt, the electrical engineer, reported that although the construction of an entirely new station would be better than the extension of the existing station, the cost would amount to £30,000 or £35,000, and that, whilst the advantages were problematical, there would be considerable risk of the undertaking being prejudicially affected financially, especially as a considerable sum would have to be provided out of revenue to replace machinery which, whilst not worth anything if not removed to another site, was still of considerable value where it was. Moreover, the site of the present station was better than any that could be suggested. The estimated cost of the additional plant recommended was £15,722.

Tynemouth.—Loan Sanction.—The T.C. has received sanction to the borrowing of £3,000 and £1,000, for mains and services respectively. The Electricity Committee has decided to charge all premises now supplied at theatre rates, 3½d. per unit up to £2 per week, and 2½d. per unit for all additional current supplied each week, as from April 1st last, and to supply electric vehicles with current at 1d. per unit, provided the demand is taken off during the winter peak periods.

Walsall.—Proposed Mains Extensions.—The Electricity Committee has recommended the extension of the mains from Marlow Street to the Darwall Street sub-station, at an estimated cost of £1,015, and application is to be made to the L.G.B. for sanction to borrow £3,000 for mains extensions.

Wednesbury.—Free Wiring Discontinued.—The T.C. has decided to discontinue forthwith the free wiring of consumers' premises.

Worcester.—Owing to the increased demand for electricity in the centre of the city, the Electricity Committee finds it necessary either to lay an additional cable or to change back to the alternating system, in which case the H.T. feeders could be used for some time. Whichever system is adopted, another sub-station will be necessary at the Cross, as the present one is taxed to its full capacity. The Committee recommends that borrowing powers for £500 be applied for for this purpose and for adapting consumers' apparatus to suit the new conditions.

Worthing.—Half-Watt Lamps.—A sub-committee of the T.C. has been appointed to report as to the desirability of substituting half-watt metal-filament lamps for the present flame arc lamps for street lighting.

U.S.A.—Municipal Power Stations.—According to the *Canadian Engineer*, an official census of municipal electricity stations in the States shows that in 1912 there were 1,562, with a total income of $23,218,989; the plants totalled 559,328 H.P., and the output for 1912 was 537,526,730 KW.-hours. The arc lamps in service were estimated at 91,851, and other lamps at over seven million, while the motors connected equalled 164,291 H.P. The income derived by municipal stations for lighting streets and public buildings is estimated where no cash income is derived. Since 1907, 310 additional stations are shown, 301 being new, while the balance represents stations taken over for municipal working.

According to the *Electrical World*, the Boston City Council is to ratify a 10-year street-lighting contract with the Edison Electric Illuminating Co., in which 5,000 6·6-amp. magnetite arc lamps are involved, and the price per lamp will be reduced from $103 to $87·5 per annum. Hartford, Conn., has adopted 300-c.p. nitrogen-filled series tungsten lamps for ornamental street lighting service, placed on 141 double and 113 single standards.

Yeovil.—Prov. Order.—The B. of T. has granted the prov. order applied for by Messrs. Petters, Ltd., of the Nautilus Engineering Works, Yeovil.

TRAMWAY and RAILWAY NOTES.

Brazil.—The whole of the power required by the Brazilian Traction Co., at Rio de Janeiro, is now being supplied by the new hydro-electric plant. It is expected that the water-power installation at Sao Paulo will also be completed during the present month.

Brighton.—Railless Traction.—The T.C. has written to the Hove Council expressing the opinion that no useful purpose will be served by an experimental route on the Cedes-Stoll system being constructed in Hove on one of the through routes, as this system is quite unsuited for the routes in question, Brighton having notified Hove that the under-running system is the one which it has chosen. The Council, however, will agree not to apply for a B. of T. arbitrator for three months from the date of the report, namely, March 23rd, provided this action is not prejudicing its position by the delay. The "through" routes in both towns have to be constructed on a system to be agreed between the two Corporations, and failing agreement, the system is to be decided by a B. of T. arbitrator.

Bristol.—The Bristol Tramway and Carriage Co. has petitioned to be heard in Parliament against the Corporation Bill. The memorial, among other contentions, urges that the Corporation Bill, taking powers to work tramways that it has not been decided to acquire, is unprecedented. It is contended that the Bill is an attempt to go behind the law which requires Board of Trade sanction to Corporation purchase. The petition, moreover, points out that the Corporation can only claim to acquire part of the Bristol system, other portions of which are on different terms, and some never acquirable, because outside the city. Further, it is contended that the employés' interest in the pension fund of the company would be lost by transfer of part of the undertaking to the city.

Dublin.—B. of T. Report.—Lieut.-Col. von Donop, reporting on the accident which occurred at Merrion Square, on February 1st, by which a Dublin United car was derailed and overturned, numerous passengers being injured, one fatally, points out that the car was entering a curve, the facing points for which are worked by the Tierney-Malone electric point controller, and that this is the first serious accident which has occurred at electrically worked facing points. He attributes the accident to the fact that the points for some reason were not lying in their normal position; to the speed of the car being too great to allow of its being stopped before running into them, and to the sudden application of the brake on the curve. He remarks that great care is required on the part of the driver to make sure of the position of his controller handle when he is running past the contacts which operate the points.

Dundee.—Railless Traction.—The T.C. has been recommended to spend £6,000 on the Clepington Road, to put it in sound condition for the railless trolley cars. Bailie Malcolm was of opinion that the system had been a nuisance to the residents all along, and if setts were put down the nuisance would be greater. Mr. Johnstone (convener) pointed out that if the road was not put in proper order they were prepared to withdraw the cars. To talk about the cars being the cause of the damage was nonsense. To this Bailie Macdonald replied that the best thing in the interest of the public was to withdraw the railless trolley cars altogether. It was ultimately agreed to remit the matter to the Works Committee for further consideration.

East and West Ardsley. — Railless Traction Scheme.—The U.D.C. has approved of a railless traction system to connect East Ardsley and Morley. The cars are to be leased to the Leeds Corporation for 28 years.

Glasgow.—All-Night Service.—The Tramways Committee has decided to ask the T.C. at the next meeting to approve of an all-night service of cars from the centre of the city to the nearer suburbs. It is proposed to run a car on each main route, leaving the city at midnight, 1, 2, 3 and 4 a.m., the cars to return from the outer termini at 12.30, 1.30, 2.30, 3.30 and 4.30 a.m. Sixteen routes are suggested.

Hastings.—The "Front" Line.—The Dolter system of tramways having been abandoned on the Front, the Corporation has requested the immediate removal of the studs. At present only four of the converted tramcars (petrol propelled) have been delivered, but others are expected. Meanwhile the service on the Front is restricted, and passengers to and from Bexhill are required to change to and from the overhead system at West Marina.

Japan.—A project is under consideration for the construction of an electric monorail railway between Nagasaki and Mogi.

Liverpool.—Suggested Tube Railways.—Mr. C. W. Mallins, the tramways manager, has submitted to the Tramways Committee a scheme for solving the problem of the congestion of street tramway traffic by a system of tubes. He puts forward the suggestion of a main trunk tube running east and west, commencing at the Landing Stage and terminating at Queen's Drive, at a point equidistant from Knotty Ash and West Derby tramway routes. The portion of the main tube between the Landing Stage and London Road would be equipped with four sets of rails, and a branch tube would form a junction with the main tube in the neighbourhood of London Road, running in a south-easterly direction, and terminating at the junction of Queen's Drive and Menlove Avenue. A second tube would commence at the junction before referred to and running in a north-easterly direction would terminate at the junction of Queen's Drive and Walton Hall Avenue. By such a system of tubes, together with through bookings from and to the various tramway routes tapping the trunk system, 50 per cent. of the present passenger traffic coming into and leaving the centre of the city could be dealt with. On the financial aspect of the scheme, Mr. Mallins states that the suggested 11 miles of tubes would cost approximately £5,500,000 to construct and equip, which, borrowed at a low rate of interest, and repayable over a long period, possibly 70 years, would not overtax the income of the undertaking in the early years of its operation. The scheme could be carried out by the unification of the whole of the existing transport systems on both the Lancashire and Cheshire sides of the Mersey, viz., the Birkenhead and Wallasey tramways, the Wirral, Mersey, and Overhead Railways (with a possible connection with the other great railways), and the Liverpool Corporation tramways. Mr. Mallins firmly believes that the proposition is commercially sound, as the revenue derivable from the combined systems would, in the near future, amount to £2,000,000 per annum, which would be ample to discharge all liabilities in connection with the undertaking, and show a reasonable profit.

London.—A petition has been presented by the companies concerned asking leave to modify the scheme for physically connecting the Great Northern and City line with the Waterloo and City railway at the Bank. Property owners having objected that the new line would be insufficiently deep, it is now proposed to lower the railway level and construct an independent station under the existing Waterloo and City station, and connected to the latter by lifts, &c. It is pointed out that unless leave to amend is given, the whole Bill may have to be withdrawn.

Last week the new tube station of the Charing Cross and Hampstead line, under the Embankment, was opened, providing a direct connection between this line and the District and Bakerloo lines at this point.

Electric Vehicle.—Messrs. J. Lyons & Co., the well-known caterers, have put into service, as an experiment, an Edison 2-ton electric vehicle with van body for the delivery of food-stuffs to their various depôts.

Extensions Abandoned.—The City Corporation has now definitely refused to sanction the extensions of the tramways to Ludgate Circus and Aldgate, and the L.C.C. has been forced to drop the schemes.

The tramway extensions from Catford to Bellingham (part of the Catford-Southend extension), and from Woolwich to Abbey Wood were opened last week.

The annual budget of the L.C.C. Finance Committee states that the tramways have failed, for the first time, to provide the full amount required for redemption of debt out of revenue, and that £91,705 will be drawn from the reserve fund for that purpose. This result is put down to motor-'bus competition; it was hoped that the use of trailer-cars and the lowering of fares would improve the financial position, though they have not so far produced much improvement.

The London United Tramways Co. has received the conditional sanction of the House of Commons to run trailer tramcars on its system.

Manchester.—B. of T. Report.—The accident in which a tramcar overturned on the curve between High Street and Upper Brook Street, on February 25th, during a fog, is stated in the report of Lieut.-Col. von Donop, of the B. of T., to have been caused through the excessive speed of the car, considering the weather; the responsibility is therefore placed on the driver.

U.S.A.—Electric Cabs.—The New York Central Railway Co. has invited tenders for 100 electric motor-cabs for service in New York. The specification stipulates for a battery capacity of 100 miles per charge, including a three-hour boost and a stated speed on the level and on gradients.

Electric Postal Vans.—The Postal Transfer Service, Inc., is substituting 20 2-ton electric trucks for petrol trucks in its contract mail service between the railways, docks and Post Offices, south of 42nd Street, New York.

The Motor Delivery Co., which has a contract for another postal section of New York, has had 28 electric cars in service since 1909. In 1913 these vehicles ran 336,000 miles in 304 days. This company has used electric vehicles exclusively.

Wolverhampton. — Year's Working. — The total receipts of the Corporation tramways for the year ended March 31st, 1914, were £56,444, an increase of £2,481 on the previous year. The passengers carried numbered 12,616,881, an increase of 703,759, and the car-miles run totalled 1,195,326, an increase of 27,087. The receipts per car-mile were 11·3d., an increase of ·247d. Motor-'bus receipts amounted to £2,070, an increase of £360.

TELEGRAPH and TELEPHONE NOTES.

German-Italian Telephone.—On April 1st, as mentioned in our last issue, the telephone line between Berlin and Milan was thrown open to the public, and the communication established has so far proved very good. The line is of hard-drawn copper, 4·5 mm. in diameter, and has Pupin coils mounted on the posts at intervals of 10 km. The route is *via* Frankfort and the Simplon Tunnel, and is 1,350 km. in length; the charge for 3 min. conversation is 4s. during the day, and about 2s. 5d. at night. This charge compares favourably with that of 5s. for the use of the line, 1,200 km. long, between Berlin and Paris. The following are among the more important European international telephone lines:—Berlin-Vienna, 686 km.; Berlin-Budapest, 970 km.; Berlin-Paris, 1,192 km.; Paris-Rome, 1,600 km.; Paris-Madrid, 1,500 km.; Berlin-Paris-Bordeaux, 1,800 km.; Berlin-Paris-Marseilles, 2,100 km. It may also be noted that within Germany itself there are several lines which rank with these as regards length; for instance, Berlin-Memel (944 km.) and Berlin-Munich (665 km.), whilst all the chief towns in Rhineland are over 630 km. from the capital. The communication with Italy was last week extended as far as Rome, which is over 1,600 km. distant, so that this is the longest direct line in Europe, whilst the charge will be only 5s. Negotiations for a connection between St. Petersburg and Berlin have been in progress for years, but do not seem to approach fruition. Telephony between Berlin and London will not be attempted until a cable is laid from English to German soil, and as this cable alone would be 450 km. long, the working results of the Dutch-English cable are being awaited before any further steps are taken; this will be opened during the coming summer. The German Post Office estimates that a 3-min. conversation between North Germany and England will cost at least 10s.

Japan.—The Japanese Department of Communications is considering the establishment of a powerful wireless station on the Pacific coast to open direct service between Japan and America.

New Wireless Telegraph Stations.—A Marconi wireless telegraph station is to be erected at Stonehaven, near Aberdeen, as a substitute for the ordinary telegraph in the event of the main overhead lines to the North being interrupted, and for other purposes. There are now 10 wireless coastal stations around Great Britain.

Work has been begun upon the new wireless station of the Government at Leafield, in Oxfordshire, which forms the English base for the Imperial wireless chain. There will be 12 steel masts 300 ft. high.

Telegraph Employés.—The first annual conference of the Postal and Telegraph Clerks' Association, which has been formed by the amalgamation of the Postal Telegraph Clerks' Association and the United Kingdom Postal Clerks' Association, was opened on Monday last at the Westminster Palace Hotel, London. The delegates present numbered 310, representing more than 20,000 members.

Last week the annual conference of the Postal, Telegraph and Telephone Controlling Officers' Association was held at Edinburgh. A resolution was adopted expressing dissatisfaction with the Holt Committee's report.

The P.M.G. has issued a statement containing the decisions of the Government with regard to the recommendations of the Holt Committee. The total cost of the concessions is estimated at £640,000 in the first year, and £1,225,000 a year eventually.

The Telephone Service.—Last week the conference of the Amalgamated Society of Telephone Employés was held in London. A resolution to the effect that a separate State department should be constituted to control the telephone service was adopted, and it was resolved that the maximum salary for female telephone operators ought to be made equal to that of female telegraph operators. A demand for a joint committee of representatives from the department and the staff, presided over by an independent chairman, to reconsider the claims of the staff as laid before the Holt Committee, was adopted. A request from the Postmaster-General, that the society should be reorganised so that persons in a supervisory position should not be in the same organisation as those whom they were supervising, was agreed to.

Replying to a question in Parliament, Captain Norton states that the average time it takes at present to connect a new subscriber with the telephone system in the cities referred to is as follows:—London, 18½ days; Birmingham, 51; Liverpool, 26; Manchester, 40; Edinburgh, 18; Belfast, 40; and Dublin, 21½. These delays are due partly to the want of spare plant, which is being met as quickly as possible by new underground schemes, and partly to the abnormal amount of work on hand for the general development of the telephone service. They also include exceptional delays due to wayleave difficulties, or to circumstances arising out of the subscribers' private arrangements.

Wireless Fog Guns.—The Clyde Navigation Trust is testing the possibility of wireless fog guns for the guidance of navigators in foggy weather. At Roseneath Patch, on the Clyde, where a new beacon has been mounted, one of the experimental guns has been placed. The gun is charged with gas, and at Gourock Pier, about two miles distant, the wireless apparatus has been installed. The gun is fired by means of this apparatus, and so far the test appears to have been satisfactory.—*The Times.*

Wireless on Board Ship.—The frequent occurrence of sparking between metallic objects on board ship, due to induction from the wireless telegraph apparatus, has attracted attention recently, as it may constitute a source of danger on ships carrying inflammable cargo. The United States Bureau of Navigation is conferring with the Board of Trade on the matter.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia. — May 12th. P.M.G.'s Department. Standard batteries for all States; Schedule No. 1,010. See "Official Notices" April 3rd.

Victorian Railways.—May 13th. One hundred enclosed arc lamps. Deposit £5. Mr. E. B. Jones, acting secretary.

May 20th. Victorian Railways Commissioners. One three-phase slip-ring electric motor and accessories. Deposit £1. Local representation. A specification can be seen at the B. of T. Commercial Intelligence Department in London.

Melbourne.—April 27th. Overhead travelling cranes for sub-stations and lifting tackle for power stations, for Melbourne Suburban Railways. See "Official Notices" April 3rd.

Sydney.—July 20th. Box compound, meters, maximum demand indicators, arc lamp carbons, and straight stem insulators, for the Council. Specifications for each section 10s. 6d., from City Electrical Engineer, Town Hall.

Blackrock.—April 23rd. U.D.C. Buildings and engine foundations, overhead travelling crane, two Diesel generating sets complete, boosters, battery, switchboard. See "Official Notices" to-day.

Belfast.—April 29th. Electric cable, for the Harbour Commissioners. See "Official Notices" to-day.

Bootle.—April 22nd. Corporation. Supply of two 500-600-kw. rotary converters, transformers and switchgear for the electricity department. Forms of tender from the Borough Electrical Engineer, Electric Light Station, Pine Grove.

Bradford.—April 23rd. Corporation. Electrical installation at Central Baths, Morley Street. Specifications from the City Architect.

Belgium.—May 4th. Electric cables (eight lots) for the Bassin Canal extension.

May 18th. Three transformer equipments, for the municipal authorities. Cahiers des charges, 5d. in each case, from the Hôtel de Ville, Antwerp.

Denbigh.—April 30th. North Wales Asylum. 700 ampere-hour battery, with booster, switchboard, &c. See "Official Notices" to-day.

Devonport.—April 27th. Corporation Gas Department. Electrically-driven jib crane and coal hoppers. Specification, &c. (£1 1s.), from Mr. I. Carr, Widnes.

Dublin.—April 17th. Corporation. Twelve months' supply of arc lamp carbons. See "Official Notices" April 3rd.

April 21st. Corporation. Repair of Lancashire boiler for the Electricity Supply Committee. Specifications from the City Electrical Engineer, Fleet Street.

Edinburgh.—April 20th. Corporation. Extension switchboard, for McDonald Road station. See "Official Notices" April 3rd.

Farnworth.—April 18th. U.D.C. Switchgear and cables. Mr. H. J. Hutchinson, Engineer, Electricity Works.

France.—April 24th. The French State Railway authorities (Bureaux du Service Electrique, 3e. division) in Paris (72, Rue de Rome) are inviting tenders for the electric cables required in connection with the electrification of the first zone of the suburban railways on the left bank of the Seine.

Germany.—April 25th. The Prussian State Railway authorities at Saarbruck are inviting tenders for the supply of 1,420 metres of telephone cable.

Glasgow.—April 27th. Corporation. 12 months' supply of cables, meters, arc lamp carbons. See "Official Notices" to-day.

Hull.—April 29th. Corporation. Steel roofwork required for the tramway workshops, Liverpool Street, for the Tramways Committee. Particulars and forms of tender from the City Engineer.

Ilford.—April 28th. U.D.C. Battery booster, storage batteries, for Goodmayes Sub-station. See "Official Notices" to-day.

Ilkley.—May 11th. U.D.C. Electricity generating station buildings. See "Official Notices" to-day.

Ipswich.—The T.C. has decided to invite tenders for the duplication of the refuse destructor, the estimated total cost being £5,200.

Leeds.—May 11th. Corporation. Steam turbine, three-phase alternator and exciter, 12,000-kw., 1,000 to 1,500 r.p.m., and condensing plant. See "Official Notices" April 3rd.

Limerick.—April 17th. Corporation. Electrical accessories, service boxes, cables, &c. See "Official Notices" April 3rd.

London.—L.C.C. April 22nd. Installation, 218 wiring points, 283 lights, at Wilson Street Elementary School, Islington, N. See "Official Notices" April 3rd.

Fulham.—April 29th. B.C. Coal for the electricity department for 12 months. Borough Electrical Engineer.

Malvern.—April 27th. U.D.C. Vertical compound steam engine, direct coupled single-phase 150-kw. alternator, exciter, &c. See "Official Notices" to-day.

Manchester.—April 21st. Corporation. Power-driven rail-bending machine. Specifications, &c., Mr. J. M. McElroy, General Manager.

May 13th. Corporation. 5,000-kw. turbo-alternator complete. See "Official Notices" to-day.

New Zealand.—Wellington.—Aluminium cable, &c., for the Public Service Stores Tender Board. Time for receipt of tenders extended to May 6th. See last issue.

Rathkeale (Co. Limerick).—April 18th. Gas engines and suction plant, dynamos, storage battery, switchboard, overhead lines and street lamps, for Rathkeale Electric Lighting and Power Co. See "Official Notices" March 27th.

Spain.—May 15th. The municipal authorities of Soria are inviting tenders for the establishment of a central electric lighting station in the town.

May.—Four electric portal cranes for the port of Cadiz. Deposit with tender £185. Junta de Obras del Puerto de Cadiz.—*Board of Trade Journal.*

Torquay.—April 20th. Corporation. Two water-tube boilers, fuel economiser, steam pipes, valves, &c. See "Official Notices" April 3rd.

Tunbridge Wells.—April 30th. Corporation. 4,000 tons of small coal for use with Underfeed stokers. Borough Electrical Engineer.

April 22nd.—Corporation. 300-kw. steam prime-mover, alternator and exciter, condenser with air and circulating pumps. See "Official Notices" April 3rd.

Walthamstow.—April 24th. U.D.C. One water-tube boiler and pipework, overhead bunkers and conveying plant, cast-iron circulating water pipes, for the Electricity Department. See "Official Notices" April 3rd.

Wigan.—April 18th. Corporation. Electrical accessories, service boxes, cables, &c. See "Official Notes" March 27th.

April 18th.—Corporation. Tramcar accessories, brake blocks, overhead line material, &c. See "Official Notices" April 3rd.

April 20th.—Corporation. H.T. feeder cable, transformer and switchgear. See "Official Notices" March 27th.

CLOSED.

Aberdeen.—The Corporation Electricity Committee has accepted the offer of Mr. Alex. Cheyne for enlarging the pumping chamber at the electricity works for £388.

Ardee.—The Ardee (Co. Louth) Town Commissioners have accepted the tender of Mr. J. W. McKeever to light the town with electricity. The neighbouring town of Collon has accepted the tender of the same contractor for electric lighting.

Australia.—P.M.G.'s Department :—

Victoria :—

250 000 pattern "B" insulators, 2·55d. each; 10,000 pattern "A" insulators 6·8d. each; 26,750 tubes, &c.—Commonwealth Art Pottery & Insulator Co., Pty., Ltd.

12,000 shackle insulators, 4¾d. each.—Lawrence & Hanson Electrical Co.

Queensland :—

One lamp signalling switchboard and recording desk, £2,361.—Western Electric Co. (Australia), Ltd.

N.S.W. Railway Department :—

Two electrically-driven turbine pumps.—Falkiner Electric Co.

One 3,000-lb. battery lorry chassis.—Standard Waygood Hercules, Ltd.

Sydney Municipal Council :—

Transformers.—N. Guthridge, Ltd.

—*Australian Mining Standard.*

Barrow.—The T.C. has placed electricity department contracts as follow :—

Engine, cylinder, crank chamber and turbine oils.—Jas. Light & Son, Ltd.
Colza and linseed oils, &c.—J. B. Bolton.
Shellac varnish and black lacquer.—Griffiths Bros. & Co.
Insulating compound and bitumen.—Dussek Bitumen Co.
Switches and pin plugs.—J. H. Tucker & Co.
Lampholders and adaptor plugs.—Simplex Conduits, Ltd.
Tin, lead, &c.—B I & Helsby Cables, Ltd.
Electric meters.—Chamberlain & Hookham, Ltd.
Prepayment meters.—Ferranti, Ltd.
Electrolytic midget meters.—Reason Manufacturing Co., Ltd.
Tantalum lamps and Osram lamps.—Drake & Gorham, Ltd.
Pope metal-filament lamps and carbon-filament lamps.—Pope's Electric Lamp Co., Ltd.
Earthenware pipes and troughs.—Doulton & Co., Ltd.
Linen tape and rubber gloves.—L. Andrew & Co.
Brass saddles and pins.—British Thomson-Houston Co., Ltd.
25-in. flame carbons.—Engineering and Arc Lamps, Ltd.
Carbons and 12-in. flame carbons.—Ship Carbons, Ltd.
Arc lamp globes and shades.—The City Glass Co.

A quotation for a motor-driven centrifugal pump (price about £100) from the Pulsometer Co. was accepted, also the tender of the Electric Construction Co., Ltd., for the electrification of the existing reciprocating pumps at the sewage pumping station, and for a new centrifugal pump and motor, the total amount being £977.

Belfast.—The Corporation has accepted the following tenders for the Electricity and Tramways Department for three years' supply of stores :—

Trolley heads.—Till & Whitehead, Ltd.
Plumbing material.—J. Baxter & Co.
Paints, &c.—Simpson & Mitchell.
Insulating material.—Spicer Bros. & Co.

For one year's supply of the following stores :—

Tramcar fittings, screws, nails and hinges.—Till & Whitehead, Ltd.
Relacquering brass and gun-metal castings.—J. Baxter & Co.
Iron castings.—J. & J. McKeown.
Maleable iron castings.—Hopyard Foundries Co., Ltd.
Springs.—W. Griffith & Sons, Ltd.
Electrical accessories.—General Electric Co.
Lamps.—Siemens Bros., Ltd.
Iron and steel.—Gregg, Sons & Phenix, Ltd.
Lubricating and gauge glasses.—R. Paterson & Sons.
Rubber and asbestos goods.—G. MacLellan & Co.
Solder.—J. Blan.
Bricks.—J. P. Corry & Co., Ltd.
Firebricks and tiles.—W. D. Henderson & Co.
Carbon-filament lamps.—Edison & Swan.
Metal-filament lamps.—General Electric Co.
Overhead line materials.—A. Wiseman, Ltd.
Galvanised steel wire.—W. D. Brown & Co.
Vulcanised bitumen cables.—Callender's Cable and Construction Co., Ltd.
Bitumen.—W. H. Keys, Ltd.
Street box frames and crown.—Gregg, Sons & Phenix, Ltd.
Cast-iron pipes.—Stanton Ironworks, Ltd.
Wrought-iron pipes.—Wellington Tube Works.
Wood troughing.—J. Gilmour.
Feeder pillars, copper cable, connections, &c.—W. Lucy & Co., Ltd.
Arc lamp carbons.—Sloan Electrical Co., Ltd.
Stoneware troughing.—Doulton & Co., Ltd.
Conduits.—T. Wragg & Sons.
Electric meters.—Chamberlain & Hookham.
Time switches.—Venner Time Switches, Ltd.
Maximum-demand indicators.—Reason Manufacturing Co., and B.I. and H. Cables Ltd.

The Corporation has also accepted the tenders of Messrs. Berch & Workman for electrical wiring at Albert Road dispensary; of Messrs. R. Dempster & Sons, for extension of coke handling and telpher plant at £8,020; and of the National Gas Engine Co. for the supply of three gas engines and Lancashire generators in connection with the electrical plant, at £2,498.

Bolton.—The Corporation has accepted the tender of Messrs. Siemens Bros. Dynamo Works for 12 months' supply of tantalum lamps.

Bristol.—The contract for the whole of the electrical work for the Bristol International Exhibition has been placed with the Electrical Engineering and Equipment Co., Ltd. It includes the supply and connecting up of underground mains, the complete system of lighting, comprising arc and metal lamps and strip lighting, together with main and distribution switchgear; also centrifugal pumps and motors for operating the waterfall and cascades.

Canada.—Montreal.—Messrs. Vickers, Ltd., of Montreal, have placed a contract with the Westinghouse Cooper Hewitt Co., Ltd., for Silica lamps for the lighting of their shipbuilding yard at Maisonneuve.

According to the *Canadian Engineer*, Messrs. Bruce Peebles and Co., Ltd., have secured contracts for two 350-kw. Peebles-La Cour motor-converters for Messrs. Armstrong, Whitworth & Co., of Montreal, and one 250-kw. ditto for the Canada Cement Co., of Montreal.

Cape Town.—The tender of Mr. A. E. Rutherford (local representative of the A.E.G. Co.) has been accepted for an electric goods elevator for Messrs. Hermann & Canard.

The tender of Messrs. E. A. Shaw & Co. has been accepted for an installation of electric lighting at the flour mills at Wellington, belonging to the South African Milling Co., Ltd.

Croydon.—The tender of Messrs. Wm. Cory & Sons has been accepted for the supply of 7,000 tons of Muirfield peas at the electricity works, at 16s. 3d. per ton.

Farnworth.—The U.D.C. has accepted the tender of the British Westinghouse Co., Ltd., for new plant for the electricity works.

Government Contracts.—The following tenders have been accepted during the past month by the Government Department named :—

Post Office.

Electric lifts.—Medway's Safety Lift Co.
Protective apparatus.—British L.M. Ericsson Mfg. Co., and International Electric Co.
Telephonic apparatus.—Automatic Telephone Mfg. Co., British L.M. Ericsson Mfg Co., Phœnix Telephone & Electric Works, Siemens Bros. and Co, and Western Electric Co.
Battery boxes.—Standard Woodwork Co.
Telephone cable.—B.I. & Helsby Cables, Ltd., Connolly Bros., Johnson and Phillips, Ltd., Siemens Bros. & Co., and Western Electric Co.
Insulators.—Doulton & Co.
Earth-plates.—T. & W. Farmiloe, Ltd.
Cable distribution plugs.—Siemens Bros. & Co.

Gravesend.—The T.C. has accepted the following tenders for additional plant :—

British Thomson-Houston Co., Ltd.—£3,772.
Mirrlees, Watson Co., Ltd.—Condensing plant, £885.
Bruce Peebles & Co., Ltd.—Converting machinery, £2,850.

Holland.—The A.E.G., of Berlin, have submitted the lowest tender (£6,296) for the supply of a 4,000-kw. steam turbine and generator for the municipal central electric lighting station at Utrecht.

Hounslow.—The Heston and Isleworth U.D.C. has accepted the following tenders for annual supplies :—

Troughs and tiles.—Leeds Fireclay Co.
Disconnecting boxes and wood bridge-pieces.—W. T. Henley's Telegraph Works, Ltd.
House fuse-boxes.—B.I. & Helsby Cables, Ltd.
House service-boxes.—Sykes & Sugden, Ltd.
Compound.—Limmer Asphalte Co.
Meters.—Reason Manufacturing Co., and Isaria, Ltd.
Oils.—Middleton Bros., J. Light & Son, and Stern-Sonneborn Oil Co.
Electrical sundries.—Cooper & Roberts, Sloan Electrical Co., W. T. Henley's Telegraph Works, Ltd., and General Electric Co.

Ilford.—The following tenders have been accepted by the U.D.C. for annual supplies to the tramways department :—

Tapes.—B.T.H. Co., Ltd., General Electric Co., Ltd., and R. W. Blackwell and Co., Ltd.
Armature coils.—P. R. Jackson & Co., Ltd.
Lampholders, &c.—Drake & Gorham, Ltd.
Carbon brushes.—Morgan Crucible Co.
Pinions.—British Hele-Shaw Patent Clutch Co.
Tires.—Brown, Bayley's Steel Works, Ltd.
Gear wheels, trolley heads, &c.—Alfred Wiseman, Ltd.
Varnish.—Robert Kearsley & Co., Ltd.
Oil.—L. Light & Son, Ltd.
Elastic journal packing.—Hall & Co.
Trolley wheels.—Anti-Attrition Metal Co., Ltd.

London and Middlesbrough.—Messrs. Siemens Bros. Dynamo Works, Ltd., have received a contract from the Middlesbrough Corporation for tantalum, Wotan, and carbon lamps during the year ending March, 1915; also one from the Asylums Committee for the County of London for tantalum and Wotan lamps.

London. — L.C.C. — The Highways Committee has accepted the following annual tenders for the supply of tramway parts, equipment, &c. :—

Spares (motor and generator).—British Westinghouse Co., Ltd., Dick, Kerr and Co., Ltd., Dyer & Young, A. Clare & Co., Manchester Armature Repair Co.
Spares (controller, circuit-breaker and other switch, &c., details, and magnetic brake).—British Westinghouse Co., Ltd , Dick, Kerr & Co.
Contact fingers and parts, segments, &c.—E. Showell & Sons, Ltd., Tramway Supplies, Ltd., Dyer & Young, British Westinghouse Co., Ltd.
Electric cable, fuse and other wire.—London Electric Wire Co. and Smith's, Ltd., Liverpool Electric Cable Co., Ltd., Callender's Cable Co., Ltd., Hooper's Telegraph Works, Ltd., Saxonia Electrical Wire Co., Ltd., B.I. & H. Cables, Ltd.
Rubber details.—I.-R., G.-P. & T. Works Co., Ltd., J. G. Ingram & Son, Irwell & Eastern Rubber Co., Ltd., North-British Rubber Co., Ltd.
Moulded insulators (other than rubber).—British Westinghouse Co., Ltd., Ebonestos Mfg. Co., Turners & Manville, Ltd., Litholite, Ltd., Crystalate Mfg. Co., Ltd.
Fibre articles.—J. Burns, Ltd., A. Cort & Co., F. A. Hill & Co.
Mica and micanite articles.—G. Schultz & Co., Ltd., Micanite & Insulators Co., Ltd.
Car furniture.—J. M. Siddell, Howarth & Housen, E. Showell & Sons, Ltd., Brush Electrical Eng. Co., Ltd., Gabriel & Co.
Machined bronze bearings.—Anti-Attrition Metal Co., Ltd.
Machine-finished articles (brass and gunmetal, &c.).—Davis & Timmins, Ltd., Anti-Attrition Metal Co., Ltd., Player & Mitchell, Ltd., E. Showell and Sons, Ltd., J. Stone & Co., Ltd., Brecknell, Munro & Rogers, Ltd.
Machine-finished articles (iron, steel, &c.).—Bayliss, Jones & Bayliss, Ltd., British Westinghouse Co., Ltd., E. H. Bentall & Co., Ltd., Bevan Lock Nut Co., Ltd., F. W. Cotterill, Ltd., Davis & Timmins, Ltd., J. Holroyd and Co., Ltd., Ibbotson Bros. & Co., F. W. Rowlands & Co., Wilkes, Ltd.]
Gear and pinion wheels, ratchets, worms, &c.—British Hele-Shaw Patent Clutch Co., Ltd., F. W. Rowlands & Co., J. Holroyd & Co., Ltd., Player and Mitchell, Ltd.
Iron and steel drop forged stampings.—Charles Bunn, Ltd., Vaughan Bros., Criterion Stampings, Ltd., Deritend Stamping Co., Ltd., Armstrong, Stevens & Son, Ltd., Woodall & Co.
Iron and steel forgings.—Male & Jordan, Brush Electrical Eng. Co., Ltd., Hurst, Nelson & Co., Ltd., Woodall & Co , Bayliss, Jones & Bayliss, Ltd., C. Bunn, Ltd., East Ferry Road Eng. Works Co., Ltd., Warren and Sons.

The Highways Committee states that for certain items two or more firms, some of them the present contractors, submitted the same prices, and the Committee has in most of these cases accepted the tender of the present contractors. The prices received for certain of the items are unfavourable, and the Committee recommends that none of the tenders therefor should be accepted.

The Highways Committee recommends that Messrs. J. Mowlem and Co.'s offer be accepted for the construction of the remainder of the authorised tramways in High Street, Wandsworth, and the authorised tramways from London Road to Forest Hill, based on their previous contract rates, with an addition of 7½ per cent. to such prices; also that the offer of Thermit, Ltd., be accepted for the supply of welding rail joint portions for the Council's tramways during 1914-15, at 19s. 6d. each. Messrs. Thermit will, in addition, supply 7½ additional welding portions free of cost for each 100 ordered by the Council. The tender of Messrs. A. Clare and Co. has been accepted for the supply of 150 trolley bases for use on Class A and D tramcars, at £3 10s. each.

Messrs. Napier-Kimber, Ltd., have secured the contract for H.M. Office of Works (bell-hanging section) for the next three years.

Stepney.—The Electricity Committee recommends that the following annual tenders for coal for the electricity works be accepted :—

A. Blackmore & Co., at 18s. 9d. per ton.
E. Foster & Co , at 13s. 8d. per ton.
J. Hudson & Co., at 18s. per ton.
The Shipping and Coal Co., at 13s. 9d. per ton.

St. Pancras.—The Electricity Committee reports the receipt of the following tenders for the supply of open arc-lamp carbons during the ensuing year :—

	65,000 pr., 10 in.	140,000 pr., 12 in.
	£ s.	£ s.
Tuchman, H.	204 15	444 10
Sloan Electrical Co., Ltd. (recommended)	186 17	483 0
Henrion Carbons	194 9	502 16
Ship Carbons, Ltd.	199 12	516 5
Geipel & Co.	200 8	518 0
Crompton & Co., Ltd.	206 18	534 6
Braulik, G.	214 17	550 1
Electrical Co., Ltd.	218 11	564 13
Siemens Bros. & Co., Ltd.	237 10	612 10
General Electric Co., Ltd.	282 15	735 0

The chief electrical engineer reported that the carbons offered by the Sloan Electrical Co., Ltd., gave the best all-round value for the Council's purposes.

The Committee recommends the acceptance of the tender of the General Electric Co. for the supply of 50,000 pairs of flame arc carbons for the "Angold" lamps for £216 5s., and that of Siemens Bros. & Co., Ltd., for 1,500 pairs of flame arc carbons for the "Beacon" lamps for £13 6s.

Battersea.—The tender of Messrs. Davidson & Co., Ltd., has been accepted by the Battersea Electricity Committee, at £57 10s., for the supply of an electric fan.

Shoreditch.—For the supply of steam coal for 12 months, the Electricity Committee recommends the acceptance of the following tenders :—

Harrisons (London), Ltd.—9,000 tons Whitwick Eureka deep seam ¾-in. slack, at 12s. 5d. per ton; 4,000 tons Manners Kilburn Tibshelf deep seam nuts, 15s. 11d.
J. Hudson & Co., Ltd.—3,000 tons Bank or Bridgeness Scotch-washed peas, at 14s. 1d.
G. I. Cockerell & Co., Ltd.—2,000 tons Yorkshire deep seam nuts, at 15s. 4d. per ton, subject to sample barge and guarantee of calorific value.

Hammersmith.—The Electricity Committee recommends the acceptance of the following tenders for annual contracts :—

Electrical goods.—General Electric Co., Ltd.
Hour meters.—Isaria, Ltd.
Insulating compound.—Dussek Bitumen Co.

The Committee also recommends that an additional 2-H.P. motor be obtained from Messrs. Langdon-Davies & Co. for hire to Messrs. Benson, at £15 15s., and that six 100-KW. transformers be purchased from the B.E. Transformer Co., Ltd., at £85 each, subject to an allowance corresponding to the reduction in price of copper.

For the supply of six 10-KW. transformers for installation in switch pillars, the following tenders were received :—

Ferranti, Ltd.	£12 15 0	each
Ferranti, Ltd. (open type) (recommended)	12 0 0	"
Electrical Engineering & Equipment Co.	12 7 6	"
B.E. Transformer Co.	14 5 0	"
Foster Engineering Co., Ltd.	14 5 0	"
Johnson & Phillips, Ltd.	15 10 0	"
Brush Electrical Engineering Co.	16 0 0	"
British Westinghouse Co., Ltd.	29 10 0	"
" " (alternative)	17 10 0	"

Sheffield.—The City Council proposes to accept the following tenders :—

Electric goods lift, £86 10s.—B. G. Smith.
Automatic passenger lift, £810.—Medway's Safety Lift Co.
20 sets transformer protection gear, £198.—A. Reyrolle & Co., Ltd.
Cable, to be made from 50 tons of H.C. copper wire and 40 tons of lead, at prices quoted.—W. T. Glover & Co., Ltd.

It is also proposed to extend the contract with Messrs. A. Reyrolle and Co., Ltd., for the supply of 14 panels of E.H.T. three-phase sub-station switchgear, at £1,682, to provide for a further 14 panels at the same price.

Stourbridge.—The U.D.C. has contracted with the British Westinghouse Electric and Manufacturing Co., Ltd., for the supply of gas engines for sale to consumers on the hire-purchase system.

Stretford.—The U.D.C. has accepted the tender of Messrs. Jardine & Co. for a rotary blower coupled direct to motor, including a 3-B.H.P. motor, for the Town Hall organ, at £72 10s.

St. Heliers.—For the electric lighting of St. Heliers, the tender of Messrs. Durell, Walker & Co., has been accepted.

Sunderland.—The T.C. has accepted tenders for the supply of cable from the B.I. & Helsby Cables, Ltd., and the Union Cable Co., Ltd.

Swindon.—The tender of the Davenport Engineering Co. has been accepted by the Council, at £496, for a new cooling tower at the electricity works.

Tynemouth.—The tender of Messrs. Ward & Son has been accepted by the Corporation for wiring work.

Wallasey.—The Corporation has accepted the tender of the British Westinghouse Electric and Manufacturing Co. for a 3,000-KW. turbo-alternator, with exciter, for £5,489, for the new works at Poulton.

Walsall.—The tender of Messrs. Johnson & Phillips has been recommended for acceptance, at £101, for a transformer, and that of Messrs. Callender's Cable Co., Ltd., for cables.

Walthamstow.—The U.D.C. has accepted the following tenders for electrical supplies for 12 months :—

Cables, flex, compound for glands, rubber and other tape.—W. T. Henley and Co.
India-rubber-covered wires.—Liverpool Electric Cable Co.
Box compound.—Dussek Bitumen Co.
Chatterton's compound.—W. Geipel & Co.
Soldering fluid, fuses, conduits, Sinclair insulators.—G.E. Co., Ltd.
P. and B. paint.—B.I. & Helsby Cables, Ltd.
Switches.—J. H. Tucker & Co.
Ceiling roses, lampholders, opal shades, bell wire.—Edison & Swan Co.
Opal and iron shades, teak blocks and key switch-holders.—British Westinghouse Co.
Fuse wire.—Wholesale Fittings Co.
Zinc rods, porous pots, dry cells, &c.—Pryke & Palmer.
Ordinary electricity meters.—Chamberlain & Hookham.
Hour meters.—Electrical Co., Ltd.
Carbons.—Sloan Electrical Co., Ship Carbons, Ltd., Siemens Bros. Dynamo Works, Ltd.
Car accessories.—British Westinghouse Co., J. W. Rowlands & Co., W. Wood & Co., Anti-Attrition Metal Co., L. Andrew & Co., Equipment and Engineering Co., Imeson, Finch & Co.
Supplies.—Electrical Manufacturing Co.
Lamps.—Crypselco Co. and G.E. Co.
Oils and grease.—C. C. Wakefield, Stern, Sonneborn Oil Co., and Vacuum Oil Co.

Warrington.—The tender of Messrs. Crompton & Co., Ltd., has been provisionally accepted, at £100, for a 35-KW. continuous-current dynamo.

West Bromwich.—The T.C. has accepted the tender of Messrs. Bruce Peebles & Co., Ltd., for a spare armature, at a cost of £1,000, to be met out of revenue.

Whitehaven.—The T.C. has accepted the tender of the Whitehaven Colliery Co. for a year's supply of dry and washed coal for the electricity works.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, April 17th. At 8 p.m. At 39, Victoria Street. Paper on "A Few Typical Carburetters," by Mr. R. S. Fox.

Saturday, April 18th. Visit to the Australia House, Kingsway.

Monday, April 20th. At 8 p.m. At Institution of Electrical Engineers, Victoria Embankment. Paper on "Lines of Future Development in High Power Diesel Oil Engines," by Mr. J. Richardson.

Tuesday, April 21st. At Imperial Hotel, Birmingham. Meeting of Midland Section. Paper on "Military Engineering," by Mr. R. B. A. Ellis.

Friday, April 24th. At 8 p.m. At 39, Victoria Street. Paper on "A Visit to the Iron Districts of French Alsace," by Mr. G. Evetts. At 7.45 p.m. At Municipal School of Technology, Manchester. Meeting of North-Western Section. Paper on "Some Notes on the Application of Chain Gearing," by Mr. H. T. Hildage.

Institution of Engineers and Shipbuilders in Scotland.—Saturday, April 18th. At 7.30 p.m. At Rankine Hall, 39, Elmbank Crescent, Glasgow. Smoking Concert.

Tuesday, April 21st. At 8 p.m. At 39, Elmbank Crescent, Glasgow. Ordinary meeting.

Nottingham Society of Engineers.—Monday, April 20th. Visit to machinery works at Leicester.

Institution of Post Office Electrical Engineers.—Monday, April 20th. At 6 p.m. At Institution of Electrical Engineers, Victoria Embankment. Annual General Meeting.

Institution of Civil Engineers.—Tuesday, April 21st. At 8 p.m. At Great George Street, S.W. Ordinary meeting.

Friday, April 24th. At 8 p.m. Students' meeting. Frame Thomson lecture on "Engineering Contracts," by Mr. A. A. Hudson.

Faraday Society.—Wednesday, April 22nd. At 8 p.m. At Institution of Electrical Engineers, Victoria Embankment. Ordinary Meeting. Papers.

Association of Mining Electrical Engineers (West of Scotland Branch).—Wednesday, April 22nd. At Royal Technical College, Glasgow. Annual meeting.

Institution of Electrical Engineers.—Thursday, April 23rd. At 8 p.m. At Victoria Embankment. Paper on "Electrification of Railways as Affected by Traffic Considerations," by Mr. H. W. Firth.

(Newcastle Local Section).—Friday, April 24th. At 7 p.m. At Hugh Bell School, Middlesbrough. Paper on "Industrial Applications of Electrically-Produced Ozone," by Mr. E. L. Joseph.

(Scottish Local Section).—Tuesday, April 21st. At 8 p.m. At 207, Bath Street, Glasgow. Paper on "Current-Limiting Reactances on Large Power Systems," by Messrs. K. M. Faye-Hansen and J. S. Peck.

Institution of Mechanical Engineers.—Thursday, April 23rd. At Connaught Rooms, Great Queen Street. Anniversary Dinner.

Friday, April 24th. At 8 p.m. At Storey's Gate, S.W. Paper on "Application of Electrical Driving to Existing Rolling Mills," by Mr. L. Rothera.

Diesel Engine Users' Association.—Thursday, April 23rd. Annual Dinner.

North-East Coast Institution of Engineers and Shipbuilders.—Thursday, April 23rd. At 7.30 p.m. Paper on "Wireless Telegraphy," by Mr. H. Fothergill.

Friday, April 24th. At 7.30 p.m. At Bolbec Hall, Newcastle-upon-Tyne. General meeting.

(Graduates' Section).—Saturday, April 25th. At 7.15 p.m. Paper on the "Gyroscopic Compass," by Mr. H. C. Stroud.

Physical Society.—Friday, April 24th. At 5 p.m. At Imperial College of Science, South Kensington. Ordinary meeting.

Batti-Wallahs' Society.—Friday, April 24th. Smoking concert.

THE ELECTRICAL ENGINEERS
(LONDON DIVISION).

Commanding Officer—Lieut.-Col. H. M. Leaf.

The following orders have been issued:—

Friday, April 17th.—"D" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Saturday, April 18th.—Headquarters will be opened for regimental purposes from 10 a.m. to 12 noon.

Monday, April 20th.—"A" Company. Technical instruction, 7 p.m. to 10 p.m. Miniature range practice, 7 to 9 p.m.

Tuesday, April 21st.—"B" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Wednesday, April 22nd.—Technical instruction and drill (Recruits), 7 to 10 p.m.

Thursday, April 23rd.—"C" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Friday, April 24th.—"D" Company. Technical instruction, 7 to 10 p.m. Miniature range practice, 7 to 9 p.m.

Saturday, April 25th.—Headquarters will be open for Regimental purposes only from 10 a.m. to 12 noon.

(Signed) F. R. Holt-White, Capt. R.E., Adjutant.
For Officer commanding L.E.E.

NOTES.

Foreign Trade in March.—The following are the electrical and machinery figures given in the official returns for March:—

Imports.	Month of Mar. £	Inc. or dec. £	Three months, 1914. £	Inc. or dec. £
Electrical goods and apparatus, excluding machinery and uninsulated wire ...	148,018	+ 30,828	429,729	+ 55,390
Machinery	724,947	+ 85,005	1,968,215	+134,323
Exports.				
Electrical goods and apparatus, excluding machinery and uninsulated wire ...	251,570	−564,103	763,509	− 776,747
Machinery	3,568,599	+809,639	9,989,948	+1,399,385

Copper.—With reference to the rumours mentioned in our leaderette pages to the effect that copper is being secretly stored on the Continent, close investigation has been made as to the truth of these reports, and without any success at all, and it can only be surmised, therefore, that the statistics correctly represent the situation. Meantime, with the more cheerful feeling which has prevailed, the producers have been able to raise their prices a little, and have done business steadily at the higher rates quoted, while there has not been so much competition on the part of the dealers to sell. These have, indeed, drawn upon their stores pretty freely within the last few weeks, and have, therefore, very little material left. With any improvement in the United States position, there might be a further advance in prices, and meantime considerable attention has been devoted to the American returns for March. These returns have now been made public, and they can only be regarded as satisfactory in so far as they indicate a revival of United States consumption, which, after being down to a little over 9,000 tons in December, have improved steadily until in March they were nearly 32,000 tons, or slightly over the average monthly takings for last year. The exports were phenomenal—40,000 tons—the nearest approach thereto being the 39,332 tons in December, 1910, while the stocks in the hands of the refineries decreased over 6,000 tons to a little less than 29,000 tons. The production, however, showed a very material increase, the total being 65,023 tons, which compares with 58,699 tons in February and 60,675 tons in January. The highest previous output in a month was 65,012 tons, in August, 1912, and the growth shown last month over recent months is naturally regarded as an unfavourable feature. The statistics were up to the more reasonable expectations which had been formed, especially in regard to home and export deliveries, but the growth of production had certainly not been looked for.

Messrs. Merton's statistical circular for the end of March shows stocks in England 9,948 tons, or 451 tons less than at the end of February, and European visible supplies 26 129 tons, a decrease of 824 tons on the month. Arrivals from North America have been brisk, from Spain and Portugal, always a small quantity, very good at 1,877 tons, against an average of under 1,200. A good supply is now derived from unclassified countries; lumped together in these figures in February these totalled 6,505 tons, and last month 5,968, and the average quantity is 4,400 tons per month. Chile shipments were just average, Australia slightly over. The total deliveries are exceptionally high, at 57,459 tons, and the steadiness of the price can only be accounted for on the grounds that the market is awaiting further information. American stocks for the end of February were 3,984 tons less than at the end of January. The world's supplies lost 2,975 tons during February, but are still a respectable figure at 61,940.

The Australian Association of British Manufacturers.—The annual general meeting of members of the Australian Association of British Manufacturers and their representatives was held at Scott's Hotel, Melbourne, on Friday, February 27th. The chairman, Mr. J. J. Horrocks, submitted the annual report, to which we have already referred (see Electrical Review, page 474).

The following members were unanimously elected as members of the Executive Council for the ensuing year:—President, Mr. Hubert Johnson; Vice-President, Mr. C. A. Cox (Cox & Mailer); Councillor, Mr. G. Smith Morison (Siemens Bros. Dynamo Works); Hardware Councillor, Mr. W. H. MacLellan; Machinery Councillor, Mr. C. W. U. Adamson (Babcock & Wilcox); Electrical Councillor, Mr. G. L. Just (Edison & Swan Electric Light Co.). A motion was unanimously carried expressing appreciation of the work done by Mr. J. J. Horrocks, as President, during the past year, and Mr. Horrocks replied suitably. Appreciative remarks were made regarding the work of the Secretary, and Mr. R. H. Butler, in replying, urged members to try to make greater use of the Association, and not to lose any opportunity of bringing forward any matters in which the Association might be of any assistance to them. He said that the Association was there to assist members, and that the greater the amount of work done the more satisfactory would matters be to all concerned.

Notes from the Rand.—Our Johannesburg correspondent writes as follows:—

An order for the electrical equipment of a large winding engine has been placed direct by the East Rand Prop. Mines, Ltd., with the British Westinghouse Electric and Manufacturing Co., Trafford Park, Manchester. The winder will be capable of raising 8 tons of ore from a vertical depth of 4,500 ft. at a speed of 2,200 ft. to 2,500 ft. per minute. The equipment consists of two 1,500-B.H.P. D.C. motors rigidly coupled to the winding drum, one on each side. These are supplied with current from a motor-generator set operating on the Ward-Leonard system, and comprising a 4,200-B.H.P., three-phase, 25-cycle, 3,000-volt motor, direct coupled to two 1,375-KW., 500-volt D.C. generators, with a direct coupled exciter for the generators and winding motors. The necessary control gear and switchgear are also to be provided by the British Westinghouse Electric and Manufacturing Co.

Thirty-five other similar installations, comparable in size with the above, have been supplied by the British Westinghouse Co., of which the following are a few examples:—

Six equipments for the "Village Deep" Gold Mine, and the "City Deep" Gold Mine, the winding motor of each equipment being of 3,400 B.H.P.

Three equipments for the Brakpan Mines, the winding motors of each being rated at 3,000 B.H.P. A similar equipment to the above is in operation at the Great Western Colliery Co., South Wales, two winding motors being installed, each capable of a maximum of 1,800 B.H.P.

The winding drum on the above E.R.P.M. installation, which

will run at the speed of the winding motor, 33·4 R.P.M., will be 12 ft to 21 ft. in diameter, and 9 ft. 3 in. between the cheeks, and will wind a rope 2 in. in diameter. The capacity of the winder will be 160 tons per hour. The winding motors will be shunt-wound, and connected in series. It will be noticed that the speed is very low. The tendency on winders at the present time is to increase the load per wind and reduce the speed.

The brake and clutch engines on this winder will be operated by compressed air from a Westinghouse slip-ring motor-driven compressor.

The Johannesburg Lighting and Tramways Department has recently placed an order for six 500-KW. 50-cycle rotary converters with the British Westinghouse Co. for traction purposes. The Johannesburg tramways are at present supplied from one central station, but the length of routes has called for some rectification of the pressure drop on the outskirts. The installation of negative boosters was seriously considered, but it was eventually decided to erect three sub-stations, one at Yeoville, one at Parktown, and the third at Braamfontein, and each will contain two Westinghouse rotaries as above.

Institution and Lecture Notes.—INSTITUTE OF MARINE ENGINEERS.—On April 4th, a party from the Institute paid a visit to the Woolwich works of Messrs. Siemens Bros. & Co., Ltd., and went through the various departments. Some time was spent in examining the details of the Hopkinson-Thring torsion meter for determining the horse-power transmitted by turbine and other shafts. In the new machine shop, amongst various ingenious electrical devices, was a tell-tale for engine revolutions. This apparatus shows, by means of a flag indicator on the bridge or in any desired position, that the propellers are in motion, and the direction in which they are rotating, a definite indication being given for each revolution. A demonstration was also given of the company's loud-speaking marine telephones, the distinctive feature of which is that a very small current is used.

IRON AND STEEL INSTITUTE.—The annual meeting of the Institute will be held in the new house of the Institution of Civil Engineers, Great George Street, Westminster, on Thursday and Friday, May 7th and 8th, 1914, commencing each day at 10.30 a.m. Amongst the papers to be read is one by Sir Robert A. Hadfield, F.R.S., and Prof. B. Hopkinson, F.R.S., on "The Magnetic and Mechanical Properties of Manganese Steels;" another, by Messrs. E. Humbert and A. Hethey, B.Sc., deals with the "Production of Steel Direct from the Ore." By the kind invitation of the Comité des Forges, the autumn meeting will be held in Paris on September 18th to 23rd, 1914. The annual dinner of the Institute will be held in the Connaught Rooms, Great Queen Street, London, W.C., on Thursday, May 7th, at 7 for 7.15 p.m., under the presidency of Mr. Adolphe Greiner.

INSTITUTE OF METALS.—Prof. E. Heyn, of Berlin, is this year to deliver the annual May lecture before the Institute on "Internal Strains in Cold Wrought Metals and Some Troubles Caused Thereby," on Tuesday, May 12th. The secretary of the Institute, Mr. G. Shaw Scott, of Caxton House, Westminster, S.W., will forward tickets to any readers who may desire to be present at the lecture.

IGRANIC ENGINEERING SOCIETY.—At the meeting of this Society, on April 1st, a paper was read on "The Electric Control of Laundry Machinery," by Mr. F. N. Pickett. The paper fully discussed the special characteristics of reversing washers, hydro-extractors, and flat-work ironers, and described the new automatic controllers which have been standardised by the Igranic Electric Co. for the correct driving and timing of reversing washers, and for the gradual acceleration of hydro-extractors. Special features of the hydro-controller are the means employed to ensure the operator's standing by during starting to guard against eccentric loading of the basket, and to prevent the current rushes to the motor becoming excessive under any possible starting conditions. The lecture was illustrated by a complete set of lantern slides, and was followed by an interesting discussion.

ROYAL INSTITUTION.—The following are among the forthcoming arrangements announced by this Institution:—

Friday evening, June 5th.—Prof. W. H. Bragg, on "X-rays and Crystalline Structure."

Tuesday afternoons, April 21st and 28th.—Dr. W. Wahl, on "Problems of Physical Chemistry."

Thursday afternoons, June 4th and 11th.—Prof. S. P. Thompson, on "Faraday and the Foundations of Electrical Engineering."

INSTITUTION OF ELECTRICAL ENGINEERS.—At the meeting of the Manchester Local Section on Tuesday last week, the paper by Mr. K. M. Faye-Hansen and Mr. J. S. Peck, on "Current-limiting Reactances on Large Power Systems," was read and discussed.

ILLUMINATING ENGINEERING SOCIETY.—On April 7th, Mr. E. Kilburn Scott read a paper on "The Lighting of Railway Carriages and other Public Vehicles."

Dinner.—The annual staff dinner of the Bournemouth and Poole Electricity Supply Co., Ltd., was held on April 1st, Mr. A. H. Sanderson, chairman of the company, presiding. About 50 persons sat down. Mr. Brightman proposed the health of the chairman and vice-chairman of the company. Dr. Hosker proposed "The Staff," and Mr. L. Ingram, the chief engineer, who replied, said he was looking forward to an output of four million units a year.

Radium.—Steps have been taken for the formation of a Central Radium Institute in Glasgow, and a public appeal is to be made for £8,000 or £9,000 for the purchase of 300 milligrams of radium for the hospitals.

Radium on Lightning Conductors.—At a recent meeting of the the Académie des Sciences, Mr. B. Szilard described experiments which have been made to determine the effect of radium when present on the point of a lightning conductor. The consequent ionisation of the air in the vicinity of the point increases its conductivity several million-fold, and the effect is detectable to considerable distances. This produces a far more intimate electrical contact between the surrounding air and the earth, reducing the potential of the former. Atmospheric charges are thus conducted harmlessly away in many cases, and the lightning flash is avoided.

Tramway Workers' Union.—In the course of an article in the *Manchester Guardian* of April 7th, it is stated that the Amalgamated Association of Tramway and Vehicle Workers increased its membership during 1913 by 6,000, making the total 27,192. There are 77 branches; the reserve funds have been increased by £3,045 to £50,037; the year's receipts were £30,797, against £27,083 for 1912. The Association is pleased to report a large number of concessions gained by negotiation; in no single case were extreme measures necessary. "To withhold labour and negotiate afterwards is a great mistake," says the general secretary.

Fatality.—An accident recently occurred at Hartlepool, by which Robert Butterly, 27, electric wireman, lost his life. Butterly was disconnecting a wire from the top of a pole at the new dock entrance. The wire had been slackened, and a section of it was resting on the ground across a railway track. An engine and train of wagons fouled the wire and drew it taut, and when, finally, the wire snapped, the pole, to the top of which Butterly was clinging, rebounded with a jerk, flinging him to the ground as though shot from a catapult. He fell on a heap of scrap iron and received injuries from which he died a few hours later.

Parliamentary.—ELECTRIC LIGHTING PROVISIONAL ORDER BILL.—No. 1 Electric Light Provisional Order Bill has been read a first time. The Bill is to confirm provisional orders made by the Board of Trade under the Electric Lighting Acts, 1882 to 1909, relating to Hawarden Rural District, Kenilworth, Ledbury, Llanfairfechan, Merthyr Tydfil (amendment), Newton-in-Makerfield, Oulton Broad, Ruthen, Slaithwaite, Thornton and Yeovil.

In the House of Commons on April 7th the Central London Railway Bill passed its third reading.

Appointments Vacant.—Mains assistant (£91), for Wishaw electricity department; mains superintendent for Worksop U.D.C. (£90). Particulars are given in our advertisement pages.

The London Electrical Dispute.—The electric wiremen's strike continues. The disability clause the men will not accept, nor will the masters withdraw it. Mr. Tate says that the L.E.M.A. cannot meet the men's representatives until they can go with authority to agree to the principle of the clause.

Educational Note.—CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—The new course will commence on Wednesday, April 29th. Examination for new students, April 28th. Particulars are given in our advertisement pages.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—In connection with the incorporation in the City of Greater Cape Town of the Municipalities of Woodstock Mowbray, Rondebosch, Claremont, Kalk Bay and Muizenburg, Sea Point, and Maitland, the entire staff of the City Council has been reorganised. The recommendations of the Reorganisation Committee with reference to the electricity department are as follows, viz.:—Power station manager, Mr. J. W. S. Clunas, present salary £350, allowance £60, recommended £450; electrical assistant, Mr. W. E. Cooke, present salary £375, allowance £9, recommended £425; distribution engineer, Mr. W. Tarleton, present salary £300, allowance £45, recommended £400; installation superintendent, Mr. G. H. Swingler, recommended £400; senior shift engineer, Mr. H. Purves, present salary £250, recommended £275; district mains superintendents, Mr. W. R. Lewis, present salary £228, allowance £12, recommended £250; Mr. J. Hegarty, present salary, £240, allowance £60, recommended £250; Mr. F. E. Burgoyne, present salary £240, allowance £12, recommended £250; Mr. G. W. Peart recommended £220; shift engineers, Mr. W. Dawson, present salary £250, recommended £260; Mr. Moore recommended £260; Mr. Allen recommended £230; assistant installation superintendent, Mr. Power, present salary £200, recommended £230; draughtsman, Mr. D. J. Wallace, present salary £220, recommended £220; chief departmental clerk, Mr. R. Williams, present salary £325, recommended £336; clerks, recommended £210 and £190 respectively; ditto, recommended two at £150 each; consumers' inquiry clerk, recommended £200; shorthand clerk and typist, £150; clerical assistants and meter reading, £570; Mr. R. J. Rosser, assistant city electrical engineer, present salary £570, allowance £24 (to be retired on pension). The above recommendations were subsequently confirmed by the Council, subject to the salary of the chief departmental clerk being fixed at £337

The South Shields Council has advanced salaries in the electricity department, as follows :—Mr. G. Robertson, station superintendent, £200—£220 ; Mr. Jas. Edgar, mains superintendent, £200—£220 ; Mr. J. C. Petersen, chief clerk and commercial assistant, £156—£175.

Mr. B. Sankey, M.I.E.E., has been promoted from the position of assistant to be municipal electrical engineer at the Port Elizabeth electricity works. Mr. L. Bickell, mains superintendent, has been appointed assistant electrical engineer.

Gillingham (Kent) T C. has appointed Mr. W. G. Sims, of Windsor, as shift engineer at the electricity works.

The staff of the Whitehaven Corporation electricity department were entertained to dinner on Wednesday evening, April 8th, at the Albion Hotel, by Mr. Eric Morton, one of the charge engineers, on the occasion of his leaving Whitehaven to take up an appointment with the Mersey Railway Co., at Birkenhead. On behalf of the staff, Mr. L. B. Hogarth, the chief engineer and manager, presented Mr. Morton with a suit case and a slide rule, and Mr. Morton responded in appropriate terms.

Mr. T. W. Hudson, of Bradford, has been appointed assistant superintendent of the Yorkshire Electric Power Co. at Ravensthorpe, near Dewsbury. Mr. Hudson was for six years works manager at the electricity works at Lancaster.

The Hove T.C. has decided to retain the services of Mr. C. B. Smith, of the Hove E.L. Co., as electrical engineer, together with his assistants and clerical staff.

The Barking Electricity Committee proposes to appoint Mr. W. Fraser as station superintendent, at an increased salary.

Mr. J. C. Banbery, of Carlisle, has been appointed shift engineer at the Barnes electricity works. There were 115 applicants.

Mr. A. Prentice, the station superintendent at the Walsall Corporation electricity works has had his salary increased from £200 to £225 per annum.

Mr. James Stanworth, electric mains superintendent at Nelson, has resigned his appointment.

Mr. E. Poole, assistant borough electrical at Durban, Natal, is leaving there on April 26th for a six months' holiday in England. His address here will be Pentowan, Hayle, Cornwall.

Tramway Officials.—Out of 39 applicants for the position of manager of the Todmorden Corporation motor-'bus department at a salary of £160 a year, Mr. E. E. Moseley, of Burnley, has been appointed.

General.—Our Cape correspondent says :—"An electrician named D. Mackenzie, lately employed at Messrs. Reynold's sugar estate, Esperanza, has disappeared. The police are making a search, but the worst is feared."

Mr. H. A. Pearson, recently of the City of London Electric Lighting Co., Ltd., has resigned his position, and in future will be representing Messrs. Allen West & Co., Ltd., and the Reason Manufacturing Co., Ltd., in London, and the South of England.

Mr. H. W. Lawrence, who has held an electrical appointment under the Soudan Government, and who has returned to this country in consequence of illness, has obtained a position at Barnsley, under the Yorkshire Electric Power Co.

Mr. Oliver Henry Kennedy, of the marine department, Messrs. Siemens Brothers Dynamo Works, Ltd., 66, Waterloo Street, Glasgow, was presented by the members of the Glasgow office staff with a silver tea set, on the occasion of his approaching marriage to Miss J. T. Muir, of Wimbledon.

Mr. George Balfour, London, has presented a solid silver cup to the Elder Park Model Yacht Club, Govan.

Mr. Maclean, district telephone manager at Reading, who is leaving to take up a similar position at Plymouth, has been presented by the staff with a combined dressing and suit case, and Mrs. Maclean with a wrist bag.

Mr. G. S. Corlett's address is now Midland Bank Chambers, Wigan. Telegrams: "Telroc," Wigan. Telephone: "No. 560 Wigan."

Obituary.—Mr. Geo. Parsons.—The death is announced from Morecambe of Mr. Geo. Parsons, of the firm of Parsons & Taylor, electrical engineers, of Bank Street and Harris Street, Bradford. Deceased, who was 66 years of age, joined the firm in 1869.

Lord Suffield.—We regret to record that the death occurred last week of Lord Suffield, who was for so long a period one of the most intimate friends of the late King Edward. Lord Suffield was a director and formerly chairman of the Westminster Electric Supply Corporation, Ltd.

We regret to learn that Mr. Robert Richardson, electrical engineer, formerly of Glasgow and lately of Leven, died at Paisley, on the 6th inst. Mr. Richardson in his early days carried out some of the first installations in Glasgow, and served for a time at Messrs. Thomson's, Clydebank, and was manager of the Faraday Co., of Govan. He was subsequently electrical engineer to the Wemyss Coal Co. and Fife tramways.

NEW COMPANIES REGISTERED.

Wright's Enterprises, Ltd. (135,162).—This company was registered on April 8th, with a capital of £5,000 in £1 shares (3,000 6 per cent. cumulative preference), to carry on the business of electricians, mechanical engineers, cinematograph and other theatre proprietors and managers, &c. The subscribers (with one share each) are :—A. T. Wright, 11, St. Edmund's Road, Bootle, Lancs., director; C. M. Thomas, 35, Penrhyn Avenue, Litherland, Liverpool, accountant's clerk. Private company. The number of directors is not to be less than two or more than five; the first are A. T. Wright and C. M. Thomas; qualification, one share; remuneration as fixed by the company. Registered office, 5, Castle Street, Liverpool.

Derrygonnelly Electric Supply Co., Ltd. (4,123).—This company was registered in Dublin on March 28th, with a capital of £500 in £1 shares, to carry on the business of electricians, mechanical engineers and manufacturers, workers and dealers in electricity, motive power and light, &c. The subscribers (with 10 shares each) are :—D. Elliott, Derrygonnelly, merchant; P. McGourty, Derrygonnelly, ex-sergeant R.I.C ; P. Leonard, Derrygonnelly, publican; W. J. Weir, Derrygonnelly, merchant; G. H. McBrien, Derrygonnelly, farmer; D. Smyth, Derrygonnelly, merchant; W. Robinson, Derrygonnelly, merchant; T. A. Smyth, Derrygonnelly, medical officer; R. Fletcher, Derrygonnelly; Rev. P. McQuaid, Derrygonnelly. The first directors are D. Elliott, T. Smyth, D. Smyth, W. J. Weir, G. McBrien, P. Leonard, W. Robinson, H. Fletcher, P. McGourty, and Rev. P. McQuaid : qualification, £10; remuneration as fixed by the company. Registered office, Derrygonnelly, Co. Fermanagh.

Venner's Electrical Cooking and Heating Appliances, Ltd. (135,159).—Registered April 8th, by E. T. Lea, 52, Queen Victoria Street, E.C. Capital, £100,000 in £1 shares. Objects: To carry on the business of manufacturers of and dealers in all electric heating and cooking devices, electricians, mechanical engineers, &c., and to adopt an agreement with R. F. Venner. The signatories (with one share each) are :—R. F. Venner, 6, Old Queen Street, Westminster, S.W., engineer; M. Tuite, Talbot Mansions, Museum Street, W.C., merchant; E. Gorer, 170, New Bond Street, W., fine art dealer; I. Simmons, 180, New Bond Street, W., art dealer. Private company. The first directors (to number not less than three or more than seven) are :—R. F. Venner (permanent, special qualification 2,000 ordinary shares), M. Tuite, E. Gorer, I. Simmons, M. Lewis, and others, to be appointed by the said R. F. Venner and the company in general meeting.

Chipping Norton Electric Supply Co., Ltd. (135,075).—This company was registered on April 4th, with a capital of £10,000 in £1 shares (5,000 5 per cent. cumulative preference), to take over the business of the Chipping Norton Electric Supply Co., and to adopt an agreement with W. A. Schultz. The subscribers (with one preference share each) are :—W. A. Schultz, 50, Cannon Street, E.C., chartered accountant; H. H. Mainwaring, 68, Breakspears Road, Brockley, S.E., civil engineer; H. T. Mainwaring, 50, Cannon Street, E.C., secretary; S. I. Perrian, 10, Clive Road, Merton, clerk; A. E. Bower, 90, Calverley Road, Catford, S.E. clerk; C. Wright, 50, Cannon Street, E.C., chartered accountant; W. V. Collings, 50, Cannon Street, E.C., gas engineer. Minimum cash subscription, £1,000; the number of directors is not to be less than two or more than five; the first are W. A. Schultz (managing director), H. H. Mainwaring and J. F. Griffiths. Registered office, 50, Cannon Street, E.C.

Tilney Manufacturing and Testing Co., Ltd. (135,069).—This company was registered on April 3rd, with a capital of £5,000 in £1 shares, to acquire licences to manufacture and sell electricity meters, to adopt an agreement with the Electricity Meters Patent Development Syndicate, Ltd., to acquire and turn to account inventions, patents or licences, to carry out experiments, tests, calibration and standardisation of apparatus submitted for that purpose, to design or make models and appliances for inventors, to set up laboratories and workshops. The subscribers are :—H. T. Harrison, 11, Victoria Street, S.W., electrical engineer, 1 share; M. J. E. Tilney, Bray, Mildred Avenue, Watford, Herts, electrical engineer, 1 share. Private company. The number of directors is not to be less than two or more than five; the first are J. E. Tilney (managing director), and H. T. Harrison. Solicitor, H. I'Anson Jones, 62, London Wall, E.C.

Electra, Ltd. (135,048).—This company was registered on April 3rd, with a capital of £3,000 in £1 shares, to carry on the business of electricians, mechanical engineers, suppliers of electricity for lighting, heating, motive power or otherwise, &c. The subscribers are :—A. Hardie, Bandoola, Holly Park Gardens, Finchley, N., gentlemen, one share; J. Woolf, 1 and 2, Rupert Court, W., electrical engineer, one share; Mrs. M. E. Hardie, Bandoola, Holly Park Gardens, Finchley, N., one share. Private company. The number of directors is not to be less than two or more than five; the first are A. Hardie, J. Woolf and Mrs. M. E. Hardie, each of whom may retain office while holding one share.

A. W. Beuttell, Ltd. (135,006).—This company was registered on April 2nd, with a capital of £10,000 in £1 shares (5,000 6 per cent. cumulative preference), to take over the business of an electric light, power, illuminating and installation engineer and contractor, carried on at 203, Victoria Street, S.W., by A. W. Beuttell. The subscribers (each with one share) are :—A. W. Beuttell, 203, Victoria Street, S.W., electrical engineer; F. Woodbridge, 5, Serjeant's Inn, E.C., solicitor. Private company. The first directors are A. W. Beuttell (governing director), F. Woodbridge, and G. A. Houghton. Registered office, 8, Army and Navy Mansions, 109, Victoria Street, S.W.

Standard Turbine Co., Ltd. (135,037).—This company was registered on April 2nd, with a capital of £1,200 in £1 shares, to manufacture, buy, sell, let on hire, and generally deal in all articles capable of being manufactured under certain patents referred to in agreements (*a*) with Improved Mechanisms, Ltd., and (*b*) with Evan Clarke. The subscribers (with one share each) are :—A. W. West, 134, Strathyre Avenue, Norbury, S.W., clerk; R. A. Keen, 125, Alscot Road, Bermondsey, S.E., clerk. Private company. Table "A" mainly applies. Registered office, 10, Old Jewry Chambers, E.C.

CITY NOTES.

Canadian General Electric Co., Ltd.

In their report for 1913 the directors state that in view of the financial stringency that existed during the year and the consequent lessening of demand they are gratified at being able to present such a satisfactory statement. A profit of $2,029,898 was earned and after deducting $470,933 for depreciation and $222,654 for interest the net balance is $1,336,309. Deducting from this amount dividends on preference and common stock at the rate of 7 per cent. per annum and a bonus of 1 per cent. on the common stock, amounting in all to $776,634, there remain surplus earnings of $559,675 ; $328,134 has been added to reserve fund and £231,541 to the balance of $682,390 at credit of profit and loss. The patents, acquired from time to time, represent a very considerable outlay, and contracts, which include trade marks and agreements with the General Electric Co. and many other companies whose Canadian rights have been acquired from time to time, are of prime importance to the successful conduct of the business. Notwithstanding their great actual value to the company, the directors recognise that these assets are of intangible value, and therefore have decided to write them down to the nominal sum of one dollar. The item of borrowed capital shows a considerable increase, on account of very large contracts that were in process of completion and not available for collection before the close of the year. The policy of the company has always been to borrow funds to finance large contracts during progress so as to avoid a fixed dividend charge in the event of any serious recession in trade.

Calcutta Tramways Co., Ltd.

The directors' report for the year ending 31st December, 1913, states that the revenue, including interest on investments and deposits, amounts to £113,271 plus £4,626 brought forward. Debenture interest absorbed £15,750, Preference share dividend £12,162, and interim dividend on Ordinary shares of 2s. 6d. per share £17,201, leaving £72,784. Out of this the directors propose to pay a final dividend of 7s. per share, making 9½ per cent for the year, £48,163; to transfer to reserve for depreciation, etc., £15,000; to staff provident fund, £1,215; and to carry forward £8,405. The reserve at the commencement of the year stood at £71,682. After deducting therefrom £6,690 written off for renewals during the year, and adding £15,000 proposed to be allocated as above, it will stand at £79,992. The steady and continued growth of the business has produced a further record in traffic receipts, which, as will be seen from the accounts, amount to £225,339, against £215,271 for 1912, or an increase of £10,068. Notwithstanding the increased mileage which has been run during the year, the operating expenses in Calcutta show a reduction of £6,523 when compared with 1912. This amount is accounted for by the reduction in the power expenses, partly due to the increased efficiency of the plant after the thorough overhauling in 1912, and partly due to the exceptional expenditure in connection therewith charged in the accounts for that year. In order to provide for expenditure which is now being incurred in further increasing the efficiency of the power station, including the provision of a new sub-station, the directors issued, at par, 2,705 Preference shares, balance of the 20,000 shares offered to the shareholders in 1907, bringing up the total Preference capital issued to £250,000. The rolling stock has been well maintained and is in first-class order.

The meeting is called for April 22nd.

Musselburgh and District Electric Light and Traction Co., Ltd.

The directors' report for the year ended 31st December, 1913, shows that the balance to credit of net revenue account is £7,168 plus £122 brought forward. Interest on debentures absorbs £4,427, and £511 is set aside for redemption of debentures, leaving £2,351. Out of this there is put to reserve and renewals account (tramways) £1,600, (lighting) £400; £257 is carried forward. The profit on the lighting undertaking shows a small increase of £30 over that for 1912. This is satisfactory considering that the amount received for energy supplied to the tramway shows a decrease of about £400, due to the more efficient working of the tramways and re-arrangement of the service. The receipts from ordinary consumers, however, show an increase of over £100 compared with those for 1912. The cost incurred for renewals to the permanent way, the principal item being the substitution of granite for whinstone setts, has been charged to tramways reserve and renewals account. There is an increase of £1,323 in the profits as compared with 1912.

	1912.	1913.
Total revenue	£15,412	£16,356
Traffic revenue	£15,224	£16,116
Passengers carried	2,312,537	2,440,770
Car miles run	430,021	411,302
Average receipts per c.m.	8.50d.	9.40d.
Average receipts per pass.	1.58d.	1.58d.
Cost of energy per c.m.	2.18d.	1.99d.
Percentage of operating costs to traffic revenue	71.86	67.03
Percentage of operating costs to total revenue	70.98	66.04

Mr. J. B. Schlesinger (Chairman) presided on April 7th at the offices, 3, Lawrence Pountney Hill, E.C., over the annual meeting. He said that in the working of the tramways there was an all-round improvement over the years 1911 and 1912, and although they had an increase in revenue there was a considerable reduction in the car mileage run, with a consequent decrease in the running expenses—a gratifying improvement. In regard to the lighting undertaking, the increase in the profit of 1912 was a small one, but it must be considered satisfactory when the consumption of electricity by the tramways was considerably less. The receipts from ordinary consumers showed a gratifying increase, and under the more energetic management now in force the revenue to be derived from this source was likely to be considerably increased. When he last addressed them he referred to the Port Seton golf course. This had now been opened, and was considered one of the best links near Edinburgh. The Port Seton Tea House Co., Ltd., had now practically finished their building; it would be ready early in June, and they were looking forward to increased traffic in consequence. The share capital remained the same, but the debenture capital had been reduced by £600 in respect of the debentures redeemed during the year. The reserve and renewals account during the year was charged with the cost of renewals to the permanent way, renewals to the cars, and depreciation for a motor 'bus sold. They had replaced nearly the whole of that expenditure by appropriating £2,000 out of the year's profits.

Mr. B. Bernheim seconded the motion, and the report was adopted without discussion.

General Electric Co., Ltd.—It is announced that the recent issue of shares was over-subscribed two and a half times.

Brush Electrical Engineering Co., Ltd.

The directors in their report for the year ended 31st December, 1913, state that the profit and loss account shows that after providing for general charges, maintenance of plant and buildings, and interest on the company's Debenture stocks, there remains a net profit of £20,062. This result has been realised from the ordinary manufacturing and trading business of the company, and is a substantial improvement over recent years, due primarily to more satisfactory prices having ruled. The directors recommend that the profit of £20,062 be applied as to £12,352 in writing down the property account to provide for depreciation in respect of the last two years, no provision for depreciation having been made for the year 1912, and as to the balance of £7,710 in reduction of the amount standing to the debit of profit and loss account in the balance-sheet. The scheme for reduction of capital submitted by the directors in 1912, and subsequently approved by the committee representing the shareholders and other interests, has been in abeyance, pending the re-establishment of an equilibrium of the profit and loss account. The scheme will now be proceeded with. The directors are of opinion that the profits may be materially improved if the company is enabled properly to exploit the Ljungstrom steam turbine, for which it holds manufacturing rights. The first turbine of this type, which, as mentioned in the last report, is installed at the Willesden power house of the North Metropolitan Electric Power Supply Co., duly completed its trial period of service, and has been taken over as a permanent unit of the station equipment. The invention is an important one which has aroused much interest by reason of its novel design and great economy in steam consumption. Valuable orders for turbines of this type have already been received, and are in course of execution, but to develop the business to the best advantage will involve some capital expenditure. The directors are giving their consideration to various alternative methods of dealing with this important development. So far, the volume of business during the current year has been well maintained, and the outlook continues favourable. The annual meeting is called for April 20th.

Indian Electric Supply and Traction Co., Ltd.

The directors' report for the year ended December 31st, 1913, states that the surplus on the year's working in Cawnpore, including £249 for interest accrued, was £10,145 (against £8,459 in 1912), and including further interest accrued in England and transfer fees, the credit side of net revenue account shows a total of £10,162; London expenditure was £1,335 (against £747 in 1912), and after providing for debenture interest, £3,600, there remains a net profit of £5,226, which, with £1,834 brought forward from last year, makes the balance at the credit of profit and loss account £7,060. Out of this amount the directors have placed £3,000 to reserve, and they recommend a dividend of 4 per cent. for the year, which will absorb £3,121, carrying forward the balance £940. The increase in London expenditure is due to the partial rectification of the secretaries' and directors' remuneration, which since 1907 has been on a voluntarily reduced scale. A chimney, an economiser and a condenser were built and installed during the autumn, and have been got into work since the new year opened, the benefits of which are now being felt.

	1912.	1913.
Supply.		
Units sold	1,189,892	1,750,368
Average price per unit	2·33d.	2·05d.
,, cost in India	1·07d.	1·00d.
Units delivered to tramway	261,680	261,960
Average price per unit	1·50d.	1·50d.
Traction.		
Miles of tramway	3½	3½
Number of cars	20	20
Passengers carried	2,859,499	2,869,484
Mileage run	263,382	269,328
Receipts per car-mile	5·00d.	4·89d.
Expenses in India	4·90d.	4·65d.
Average fare per passenger	·45d.	·45d.

Clevedon, Portishead and District Electrical Supply Co., Ltd.—A meeting of the shareholders in this company was held on the 8th inst., Mr. T. Richards presiding. The chairman, in moving the adoption of the report and accounts, said the undertaking was making steady progress, and the revenue had increased during the last three months by at least a third over the previous five months' working. Mr. F. Christy, in seconding the resolution, spoke of the need of further capital to extend the system to the Long Ashton district. The resolution was carried, and directors appointed.

British Columbia Electric Railway Co., Ltd.—The directors have declared an interim dividend at the rate of 8 per cent. per annum on the deferred ordinary stock, in respect of the last half-year of 1913.

South London Electric Supply Corporation, Ltd.—The recent issue of 6,000 6 per cent. cumulative preference shares was largely over-subscribed, and letters of allotment and regret were posted on 11th inst.

Altrincham Electric Supply, Ltd.—The directors' report for the year ended December 31st, 1913, says that during the year 114 new installations were connected to the mains, and the number of consumers on December 31st last totalled 1,482. Further capital expenditure amounting to £5,743 was incurred during the year. Of this, £3,741 was in respect of new plant, meters, &c., £1,748 for cable extensions, and £254 for the new order to cover the extended area. The accounts disclose a profit of £8,259 for the year, after providing for interest on debentures and loans, making, with £175 brought forward, an available balance of £8,433, which has been dealt with as follows:—Written off old stock, £642; machinery replacements, £317; debenture discount account, £250; debenture (sale of) account, £227; general reserve fund, £1,000, leaving £5,996 to be carried forward. Out of this the directors recommend a dividend of 8 per cent. for the year, absorbing £2,800.

Stock Exchange Notices.—Applications have been made for special settling days in:—

Toronto Power Co., Ltd.—Prov. Scrip, fully and partly (£25 per cent.) paid, for £523,655 4½ per cent. consolidated guarantee debenture stock.

And for official quotations in the following:—

Columbia Gas and Electricity Co.—$50,000,000 capital stock in shares of $100 (renewed application).

Costa Rica Electric Light and Traction Co., Ltd.—Further issue of £30,050 5 per cent. first debentures, Nos. 2,557 to 2,722 and 2,757 to 2,766 (£100), and 1,631 to 1,879 (£50).

The Committee has appointed a special settling day as under:—

Tuesday, April 28th.—British Electric Transformer Co., Ltd.—Further issue of 16,886 ordinary shares of £1, fully paid, Nos. 119,115 to 135,879 and 135,394 to 135,464.

And ordered the following to be quoted in the Official List:—

British Electric Transformer Co., Ltd.—61,988 6 per cent. cumulative preference shares of £1, fully paid, Nos. 1 to 50,000 and 150,001 to 161,988.

Metropolitan Railway Co.—Further issue of 266,666 3½ per cent. "A" debenture stock.

Shropshire, Worcestershire and Staffordshire Electric Power Co., Ltd.—An extraordinary general meeting was held on April 8th at the offices of the Electrical Federation, Kingsway, under the chairmanship of Mr. E. Garcke, for the purpose of considering and if thought fit approving the Bill deposited in Parliament to confer further powers on the company. The chairman, in moving the formal resolution approving the Bill, said that it provided for the issue of further shares and for the reconversion of stock into shares, and contained the usual clauses relating to the issue of capital. It also removed the obligation to hold half-yearly meetings. It was a late Bill, but there was nothing controversial about it, and he did not think it would be contested in any way. The resolution was carried.

Launceston and District Electric Supply Co., Ltd.—The directors in their second annual report state that the rapid growth of the business in 1912 was continued throughout 1913, the number of customers at the end of the year was 174 and the lamps 4,500. The total revenue receipts were £959, and the working expenses £738, leaving a net profit of £220, plus £2 brought forward, making a total of £222. This the directors recommend should be allocated as follows:—2½ per cent. dividend on ordinary shares, less tax, £151, carrying forward £72. The number of units distributed during the year was 45,328. The whole of the company's plant and machinery has been maintained in perfect order. In November, 1913, 2,500 £1 5 per cent. preference shares were created, and the whole of these have now been issued. The directors do not ask for any remuneration for their services.

Direct United States Cable Co., Ltd.—The directors report that for the year ended March 31st, 1914, the reserve fund account shows a balance of £451,491, as compared with £487,474 at March 31st, 1913, a decrease of £35,983, which is accounted for by expenditure in connection with the repair of the main cable in mid-Atlantic in July, 1913. Three quarterly interim dividends of 2s. each per share (less income-tax), amounting to £34,301, have been declared and paid during the year, and a final dividend of 2s. per share (less tax) is now proposed, making a total distribution of 4 per cent. for the year.

Nairobi Electric Power and Lighting Co., Ltd.—The directors report that the results of last year's working show that the net profits for 1913 are largely in excess of those of 1912, and that in consequence they have resolved to pay by way of an interim dividend the whole of the arrears of dividend on the 6 per cent. preference shares up to the end of 1913 (24 per cent.), which will leave a substantial balance to be dealt with as may be decided later.

Stratford-on-Avon Electricity Co., Ltd.—The directors' report to December 31st, 1913, states that after writing off £200 to reserve and depreciation account and building sinking fund, the net revenue account shows an available balance of £480. The directors recommend a dividend of 4 per cent., requiring £296, and directors' fees absorb £50, the balance, £134, being carried forward.

Mexican Light and Power Co.—The directors have issued an announcement to the effect that as the conditions in Mexico have not improved they have now decided to suspend the half-yearly payment of the dividend on the 7 per cent. cumulative preference shares. The payment of dividends on the ordinary stock was discontinued in January.

Guildford Electricity Supply Co., Ltd.—Mr. H. P. Smallpeice presided at the annual meeting held recently. He said that the company had again made very satisfactory progress. The receipts amounted to £11,785, as compared with £10,068 for 1912. That was, unfortunately, gross revenue, and that satisfactory increase had to be met by a considerable increase on the expenditure side, with the result that the balance applicable for distribution amounted to £1,165, which was only £91 in excess of the previous year. The increased expenditure on revenue account was mainly in respect of coal and other fuel, £940. After referring to other items, he said, that considering all things, he thought they might fairly congratulate themselves that the directors were able to recommend the payment of the usual dividend of 5 per cent. on the ordinary shares, and carry forward a slight increase to the credit of the revenue account for the current year. It was resolved that the remuneration of the directors be increased from 200 guineas to 250 guineas.

Babcock & Wilcox, Ltd.—The directors' report states that the net profit during the year 1913 amounts to £446,073, plus £64,014 brought forward, making £510,087. The interim dividends of 3 per cent. on the preference shares, and of 7 per cent. on the ordinary shares, amounted to £119,200, and the directors recommend the following final dividends:—3 per cent. on the preference shares for the December half-year, requiring £3,000, 5 per cent. per annum to December 31st, 1913, on the second preference shares, £4,652, 9 per cent. on the ordinary shares (free of income-tax) for the December half-year, £149,400; placing to the reserve fund £150,000, and granting to the staff pension fund £10,000, and leaving £73,835 to be carried forward. The business continues to progress, and the orders on hand at January 1st, 1914, were in excess of those carried over at January 1st, 1913. "We are continuing to enlarge the scope of our business, in view of the fact that under the present conditions of manufacturing a larger output is required to keep up our profits. Our works have been maintained in excellent order, and extensions have been carried out."

Brisbane Electric Tramways Investment Co., Ltd.—The report for 1913 (according to the *Financial Times*) states that the dividend received from the Brisbane Tramways Co., Ltd., amounted to £115,922. There is an available balance of £115,848, which the directors have dealt with as follow:—In allocating to reserve fund (bringing it up to £50,000) the sum of £40,000; in payment of debenture stock interest £19,068, and of preference dividend £17,656, and of an interim dividend on the ordinary shares £18,000. The directors now recommend a balance dividend of 4s. per share, free of income-tax, on the ordinary shares (making 8 per cent. for the year), and that £3,123 be carried forward. The allotment letters for the 30,000 new ordinary shares of £5 each will be posted to the shareholders with the dividend warrants.

Thomas Tilling, Ltd.—In their report for 1913 the directors state that during the year the company has considerably increased its interest in the business of W. A. Stevens, Ltd., motor manufacturers and engineers, who are the patentees and manufacturers of the "Tilling-Stevens" motor vehicles. Substantial profits were earned by this company during the year 1913, and there is every expectation that now the works are nearly completed the profits for the current year will show a considerable increase.

Monte Video Telephone Co., Ltd.—The directors have declared interim dividends for the half-year to January 31st at the rate of 5 per cent. per annum on the preference shares and 6 per cent. per annum on the ordinary shares.

Sao Paulo Tramways, Light and Power Co., Ltd.—The directors have declared a dividend of 2½ per cent.

STOCKS AND SHARES.

Tuesday Evening.

The Stock Exchange returned from its Easter recess with more hope than conviction that the long end-April settlement will bring out more business than it enjoyed before the holidays. Notwithstanding the abundance of money and the difficulty of employing it at remunerative rates, there is still a disinclination on the part of the investor, and of the speculative investor as well, to embark upon Stock Exchange activities. In some few markets, particularly that devoted to oil shares, noticeable animation prevails; but the business is very specialised, and at present gives little indication of broadening out into a more general stream.

The dullness of Consols is one of the things which acts as a drag upon purely investment securities. In spite of this, however, new issues continue to secure willing support from the public. As an instance, the success of the General Electric emission may be quoted, the subscription lists for Ordinary and Preference shares being closed in advance of the date specified in the prospectus, and a premium of 5s. being at once established upon each class of shares.

The new County of London Electrics are also better, the price in their case hardening up to nearly 10s. premium, buyers having

come along for these in preference to the older shares, although realisations of the latter, in order to provide funds to take up the new issue, have now ceased. The South London Preference issue rapidly went, from all of which signs it may be judged that where a *clientèle* more or less ready-made can be appealed to with an offer of shares, there will be little difficulty in obtaining over-subscription.

It is proposed to eliminate from the pages of the Stock Exchange Daily Official List the quotations for Folkestone Preference, Newcastle Debenture and Oxford Debenture, on the ground that no bargains have been recorded in either of them since January 1st, 1913. Unless transactions are marked between now and the end of the month, the prices for these shares will be transferred to what is known as the "Removed List" of the Stock Exchange Weekly Intelligence.

The matter is worth mentioning, in view of the tentative proposals which have been made lately for combining some of the provincial electric lighting companies by means of a holding company in the nature of a trust. Many of the provincial companies, of course, do exceedingly well—as witness the 7 per cent. dividend recently declared by the Bournemouth and Poole Company; but the shares seldom move, because there is nobody to take sufficient interest in them for them to get distributed over any wide circle of holders. It is argued in favour of the proposal that many people, particularly in country localities, would be glad enough to acquire a holding in a trust company owning shares in first-class concerns paying good dividends; and more will probably be heard of this scheme before long.

Prices of the shares in the Electric Supply market are generally steady, though there is some dullness in Westminsters, and Cities remain at their previous quotation of 17½. The withdrawal of the London Electric Supply Bill came as no surprise; in fact, its passage this session had not been generally expected. That there will be some revival of the scheme, although, maybe, in another form, is likely enough. Westminster Ordinary are ¼ down at 8½, but Folkestones hardened to 4⅛. Bournemouths rose to 10½; probably this price could be obtained by a seller.

The Home Railway market arrived at the conclusion that the Labour trouble on the South Yorkshire Coalfield was not likely to be either extensive or prolonged. With the Easter prospects in sight, and in spite of half-hourly changes in the weather, prices were advanced, on the idea that bumper traffics would be secured, or, at any rate, that the newspapers which publish railway advertisements could be relied upon to write up the holiday traffics in their usual boom style.

With the improvement in the heavy stocks came modest advances in the Undergrounds. The opening of the new loop at Charing Cross had a strengthening effect upon Underground Electric shares, the "A" variety hardening to 9s. 3d., while the £10 shares rose 10s. and 6 per cent. Income bonds gained 1½. London and Suburban Tractions have dropped a little. London United Tramways Debenture is a point down. Vague rumours about "funding the dividend arrears" helped the advance in Underground Electric £10 shares. Nothing tangible seems to be known.

The Marconi market was further upset by the official announcement that the American Marconi Company would not pay any dividend on its Ordinary shares in respect of the eleven months to December 31st, 1913. In the previous year, 2 per cent. was paid; but for 1913 the company earned a shade less than this on its capital, and the figures in the balance-sheet evidently frightened nervous holders, for the price dropped to 16s. This had the effect of bringing the parent shares on offer at 3⅜, while Canadians were dull at 8s. 6d., though there has been a slight recovery from the lowest prices since the American Company's report appeared. It is announced that the parent company has just received a contract from the Government for erection of another station at Stonehaven.

The Telegraph market as a whole is quietly firm, business, however, having been on retail lines, and changes in quotations being so small as scarcely to call for mention. The Direct United States Cable Company has declared a dividend of 2s. a share, making 4 per cent. for the year, which was in accordance with market expectations. The report is a satisfactory one. Western Telegraphs are moving up again.

The Mexican see-saw this time has tipped against the shareholders in the various companies. Falls have occurred of 3 in Mexico Trams, of 4 in Mexican Light and Power Common, and 3 in the Preferred shares. Although another assurance has been received from one of the many generals in the field, to the effect that British property is to be respected, the action of the U.S. Government in sending its fleet to Mexico, is fraught with too many possibilities for the market in all Mexican securities to be anything but nervous. Shawinigan Water new stock is officially valued at 12 premium for temporary purposes, and the price of the old shares (138) is *ex* dividend and *ex* rights. Brazil Tractions have also receded a little, on the vagaries of the rate of exchange. The fall in other Brazilian securities, however, has been checked.

Babcock & Wilcox fell sharply to 3, a drop of $\frac{3}{16}$, on the declaration of a dividend of 9 per cent., making 16 per cent. for the year, the same as that for the previous 12 months. Better results than this had been expected, and the market in the North was evidently upset. On the other hand, Brush Debentures of both kinds have been put up, on the appearance of a favourable report, which had the effect of raising the quotations of both stocks to the extent of 3 points. Castner-Kellners are also harder, and Callender's Preference advanced to 5⅛. Edison & Swan receded to the nominal price of 1s. 3d., and British Westinghouse Preference have gone back $\frac{3}{32}$, further sellers having come in on the top of the rise brought about by the improved position of the company, as shown by the recently-issued figures.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, April 15th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	per lb.	2¾d.	..
a „ Sulphuric	per cwt.	5/6	..
a Ammoniac Sal	„	42/-	..
a Ammonia, Muriate (large crystal)	per ton	£30 10	..
a Bleaching powder	„	£6 5	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£17 10	..
a Copper Sulphate	„	£22	10s. dec.
a Lead, Nitrate	„	£30 10	..
a „ White Sugar	„	£28	..
a „ Peroxide	„	£32	..
c Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (88/90 %)	per ton	£22 10	..
a „ Chlorate	per lb.	8¾d.	..
a „ Perchlorate	„	8⅝d.	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	„	7½d.	..
a Shellac	per cwt.	75/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	„	£8 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70/72 %)	„	£10	..
a „ Chlorate	per lb.	9¾d.	..
a „ Crystals	per ton	£2 5	..
a Sodium Bichromate, casks	per lb.	3d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£86	..
b „ Wire, in ton lots (1 to 14 S.W.G.)	„	£112	..
b „ Sheet, in ton lots	„	£112	..
p Babbitt's metal ingots	„	£50 to £221	..
c Brass (rolled metal 2" to 12" basis)	per lb.	7½d.	..
c „ Tube (brazed)	„	9⅜d.	..
c „ „ (solid drawn)	„	8d.	½d. inc.
c „ Wire, basis	„	7⅜d.	..
c Copper Tubes (brazed)	„	10d.	..
c „ „ (solid drawn)	„	10d.	..
g „ Bars (best selected)	per ton	£82	£2 inc.
g „ Sheet	„	£82	£2 inc.
g „ Rod	„	£82	£2 inc.
d „ (Electrolytic) Bars	„	£68	£1 10 inc.
d „ „ Sheets	„	£86	£1 10 inc.
d „ „ Rods	„	£78 10	£1 10 inc.
d „ „ H.C. Wire	per lb.	8½d.	⅛d. inc.
f Ebonite Rod	„	4/6	..
f „ Sheet	„	4/-	..
n German Silver Wire	„	1/10	..
h Gutta-percha, fine	„	7/-	..
h India-rubber, Para fine	„	2/11½	½d. dec.
f Iron Pig (Cleveland warrants)	per ton	50/11	9d. inc.
„ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Pig	„	£18 10 to £18 15	£2 dec.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£7	..
c Mica (in original cases) small	per lb.	6d. to 8s.	..
c „ „ „ medium	„	8/6 to 6/-	..
c „ „ „ large	„	7/6 to 11/-	..
o Nickel, sheet, wire, &c.	„	3/6 to 4/6 nom	..
p Phosphor Bronze, plain castings	„	1/1 to 1/3½	..
p „ „ rolled bars & rods	„	1/0½ to 1/2	..
p „ „ rolled strip & sheet	„	1/2½ to 1/5½	..
o Platinum	per oz.	185/-	..
d Silicium Bronze Wire	per lb.	10½d.	..
r Steel, Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£166 to £167	£7 dec.
g „ Wire, Nos. 1 to 16	per lb.	2/4	..
p White Anti-friction Metals	per ton	£44 to £194	..
k Zinc, Sh'ts (Vieille Montagne bnd.)	„	£25 12 6	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons
o Johnson, Matthey & Co., Ltd
p
r W. F. Dennis & Co.

Oldham, Ashton and Hyde Electric Tramways, Ltd.

—In their report for 1913 the directors state that the total revenue was £35,496, and the expenditure (including £1,600 for debenture interest and £4,500 placed to provision for renewals account) £28,816, leaving a net profit of £6,679, plus £218 brought forward. The directors propose to place to reserve fund, £1,250; dividend, 5 per cent. per annum on the cum. preference shares, £2,500; dividend on the ordinary shares 7 per cent. per annum for the six months to December 31st, making, with the interim dividend, 6 per cent. for the year, £3,000; leaving to be carried forward £147. During the year £192 was expended on capital account. The directors ask sanction to the conversion of the preference and ordinary shares into shares of £1 each. The increase in the traffic receipts of £1,009 is due to the general prosperity of trade in the district. £4,500 has been charged through the revenue account to renewals account, as compared with £4,000 for 1912.

SHARE LIST OF ELECTRICAL COMPANIES.

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations April 14th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	* 1	Nil	..	⅛ — ¼	..	Nil
Do. 5 % Pref.	1	5	5	⅜ — ½	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	70 — 75	+1	6 0 0
Brit. Elec. Trac., 6 % Pref.	100	..	..	15½ — 17½	..	..
Do. Do. Deferred	100	..	..	6½ — 8½	..	..
Do. Do. 6 % Cum. Pr'f.	100	6	6	89 — 92	..	6 10 5
Do. 7 % Non-Cum. Pr'f.	100	8	..	56 — 59	..	5 1 8
Do. 5 % Perp. Deb.	100	5	5	93 — 95 xd	..	5 1 0
Do. 4½ % 2nd Deb.	100	4½	4½	79 — 82	..	5 9 9
Central London Railway, Ord.	100	8	8	57 — 62	..	4 16 9
Do. Gtd. Assented	100	..	4	81 — 83	..	4 16 5
Do. Pref.	100	4	4	68 — 73	..	5 9 7
Do. Gtd. Assented	100	..	4	82 — 84	..	4 15 8
Do. Def.	100	2	2	40 — 45	..	4 9 0
Do. Gtd. Assented	100	..	4	79 — 81	..	4 18 7
Do. 4 % Deb.	100	4	4	97 — 99	..	4 0 10
City & S. London, 5 % Pref., 1891	100	5	5	95 — 97	..	5 3 1
Do. Do. 1896	100	5	5	91 — 94	–1	5 6 5
Do. Do. 1901	100	5	5	89 — 92	..	5 8 8
Do. Do. 1908	100	5	5	89 — 92	..	5 8 8
Do. 4 % Deb.	100	4	4	88 — 90	..	4 9 0
Hastings Trams, 6 % Pref.	1	6	6†	⅜ — ½	..	8 0 0
Do. 4½ % Deb.	100	4½	4½	65 — 70	..	6 8 7
Isle of Thanet Trams, 5 % Pref.	5	2½	3	2 — 2½	..	6 0 0
Do. 4 % Deb.	100	4	4	71 — 76	..	5 5 8
Lancashire United, 5 % Deb.	100	5	5	87 — 89	..	5 12 4
London and Suburban, Ord.	1	..	..	⅛ — ⅜	..	..
Do. Do. 5 % Cum. Pref.	1	..	5†	⅛ — ⅜	–⅛	6 19 0
Do. Do. 4½ % 1st Deb.	100	4½	4½	78 — 83	–1	5 8 5

NAME.	Stock or Share.	Dividends for 1912.	Dividends for 1913.	Closing Quotations April 14th.	Rise + or Fall —	Present Yield p.c. £ s. d.
London Elec. Railways, 4 % Deb.	100	4	4	90 — 92	..	4 7 0
London United Trams, 4 % Deb.	100	4	4	59 — 63	–1	6 7 0
Metropolitan Railway Consol.	100	1⅛	1⅛	42½ — 43½	..	3 15 2
Do. Surplus Lands	100	2¼	2¼	63 — 65	..	4 4 7
Do. 3½ % Deb.	100	3½	3½	87 — 89	..	3 18 7
Do. 3½ % Pref.	100	3½	3½	82 — 84	..	4 3 4
Do. 3½ % Con. Pref.	100	3½	3½	80 — 82	..	4 5 4
Metropolitan District Ord.	100	Nil	..	20½ — 20¾	+ ⅛	Nil
Do. 6 % Deb.	100	6	6	138 —141	..	4 5 1
Do. 4 % Deb.	100	4	4	93 — 95	..	4 4 3
Do. 4 % Prior Lien	100	4	4	97 — 99	..	4 0 10
Do. 4½ % First Pref.	100	4½	4½	84 — 87	..	5 3 6
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 12 1
Metro. Elec. Trams, 4½ % Deb.	100	4½	4½	89 — 92	..	4 17 9
Do. 5 % Deb.	100	5	5	85½ — 88½	..	5 18 0
Potteries, Ord.	1	3½	..	⅛ — ¼	..	..
Do. 5 % Pref.	1	5	5	⅛ — ¼	..	7 12 8
Do. 4½ % Deb.	100	4½	4½	84 — 87	..	5 3 6
South Metro. Trams, 6 % Pref.	1	6	6†	⅜ — ½	..	8 0 0
Do. 4 % Deb.	100	4	4	66 — 70	..	5 14 4
Underground Elec. Railways	10	..	..	8⅜ — 8⅝	+ ⅛	Nil
Do. "A"	1/-	..	..	⅛ — ⅜	+⅛	Nil
Do. 6 % First Cum. Inc. Deb.	100	6	6	112 —114	..	5 5 3
Do. 4½ % Bonds	100	4½	4½	99½ —101½	+ ½	4 8 8
Do. 6 % Income	100	6	6	91½ — 92½	+1½	6 8 6
Yorkshire (West Riding). Ord.	5	Nil	..	⅛ — ⅜	..	Nil
Do. 6 % Pref.	5	3	4	4 — 4½	..	4 9 0
Do. 4½ % Deb.	100	4½	4½	83 — 86	..	5 4 8

ELECTRIC RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5½	5½	4⅝ — 4¾	..	5 12 10
Do. 2nd Pref.	5	5¼	5¼	4⅜ — 4⅝	..	6 0 7
Do. 4 % Deb.	100	4	4	92½ — 94½	..	4 4 8
Do. 4½ % Deb.	100	4½	4½	97 —100	..	4 10 0
Do. 5 % Deb.	100	5	5	96½ — 98½	..	5 1 6
Auckland Trams, 5 % Deb.	100	5	5	103 —106	..	4 14 3
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅜ — 11⅜	..	5 4 4
Do. 4½ % Deb.	100	4½	4½	94½ — 96½	..	4 13 3
Do. 5 % 2nd Deb.	100	5	5	98 —100	..	5 0 0
Brazilian Traction, Light and Power	$100	6	6†	83 — 85	— ½	7 1 2
Brisbane Trams Invt., Ord.	5	8	8	7⅞ — 8	..	5 0 0
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	98 —101	..	4 9 1
B. Columbia Elec. Rly., Def.	100	8	8†	117 —121	..	6 12 4
Do. Pref. Ord.	100	6	6	105 —109	..	5 10 1
Do. 5 % Pref.	100	5	5	104 —105	+1	4 15 2
Do. 4½ % 1st Mort. Deb.	100	4½	4½	98 —101	..	4 9 1
Do. 4½ % Vancouver Deb.	100	4½	4½	94 — 98	..	4 12 0
Do. 4½ % Con. Deb.	100	4½	4½	93¼ — 95½	..	4 9 1
Calcutta Trams, Ord.	5	7½	9½	7 — 7½	+ ⅛	6 6 8
Do. 5 % Pref.	5	5	5	5 — 5¼	..	4 15 3
Do. 4½ % Deb.	100	4½	4½	96 — 99	..	4 11 0
Cape Electric Trams	1	5	5	⅜ — ½	..	6 18 4
City Buenos Aires Trams (1904)	5	5	5	5¼ — 5⅝	..	4 10 11
Do. 4 % Deb.	100	4	4	91 — 96	..	4 3 4
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	89 — 93	..	5 7 8
Havana Elec. Rly., 5 % Bonds	$1000	5	5	93½ — 97½	..	5 2 6
Kalgoorlie Elec. Trams	1	N	..	0 — ⅛	..	Nil
Do. 5 % A Deb.	100	5	5	85 — 90	..	5 11 1
Do. 6 % B Deb.	100	3	..	10 — 20	..	Nil

La Plata Elec. Trams, Ord.	1	..	..	⅛ — ¼	..	..
Do. Pref.	1	4½d.	6	½ — 1	..	6 0 0
Lisbon Elec. Trams, Ord.	1	6	6†	1⅛ — 1⅜	..	4 7 8
Do. 6 % Pref.	1	6	6	1⅜ — 1⅝	..	5 1 0
Do. 5 % Deb.	100	5	5	91 — 96	..	5 4 2
Madras Elec. Tr., 6% Cum. Pref.	5	6	6	4½ — 5½	..	5 14 3
„ Elec. Tr. (1904), Deb.	100	5	5	101 —103	..	4 17 0
Manaos Trams & Lt., 1st Deb.	100	5	5	79 — 82	..	6 2 0
Manila Elec. R. and Ltg., Bonds	$1000	5	5	98¾ —100½	..	4 19 6
Mexico Trams Com	$100	7	7	71 — 74	–3	..
Do. Gen. Con. 5 % Bonds	..	5	5	79 — 83	..	6 0 6
Do. 6 % Bonds	100	6	6	78 — 83	..	7 4 7
Para Elec. Rlys. & Lt., Ord.	5	10	10	3½ — 4⅜	..	11 8 6
Do. 6 % Pref.	5	6	6	4 — 4½	..	6 13 4
Do. 5 % 1st Deb.	100	5	5	89 — 92	–1	5 8 8
Rangoon El. Tr. & Sup., Pref.	5	6	6	5 — 5½	..	5 9 1
Do. 4½ % 1st Deb.	100	4½	4½	95 — 97	..	4 12 9
Rio de Janeiro Trams, 1st Mort. 5 % Bonds	..	5	5	97 — 99	..	5 1 0
Do. 5 % Mort. Bonds	100	5	5	90 — 92	+1	5 8 8
Sao Paulo Tram., Lt. and P. 5 % 1st Deb.	$500	5	5	98 —101	..	4 19 0
Singapore Trams, 5 % Deb.	100	5	5	88 — 92	..	5 8 8
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 97	..	5 3 0
Un. Elec. Trams Monte Video	5	7	7	4⅝ — 5⅛	..	6 16 7
Do. 6 % Pref.	5	6	6	4¾ — 5⅛	..	6 3 1
Do. 5 % 1st Deb.	100	5	5	95 — 98	+1	5 2 0
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	93½ — 95½	..	4 14 3

ELECTRICITY SUPPLY AND POWER COMPANIES.—HOME.

Bournemouth & Poole, Ord.	10	6	7	10 — 11	+ ½	6 7 4
Do. 4½ % Pref.	10	4½	4½	9 — 10	..	4 10 0
Do. Second 6 % Pref.	10	6	6	10½ — 11½	..	5 11 7
Do. 4½ % Deb. Stock	Stock	4½	4½	95 — 98	+1	4 11 9
Brompton & Kensington, Ord.	5	10	10	8⅞ — 9¼	..	5 8 1
Do. 7 % Cum. Pref.	5	7	7	8¼ — 8⅝	..	4 0 0
Central Electric Supply, 4 % Guar. Deb.	100	4	4	91½ — 94½	..	4 4 8
Charing Cross, West End & City	5	5	6	4⅛ — 5⅜	..	5 11 7
Do. 4½ % Cum. Pref.	5	4½	4½	4½ — 5	..	4 10 0
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	4 — 4½	..	5 0 0
Do. Do. 4 % Deb.	100	4	4	92 — 94	..	4 5 1
Chelsea, Ord.	5	5	5	4⅜ — 5	..	5 0 0
Do. 4½ % Deb.	Stock	4½	4½	97 — 100	..	4 10 0
City of London, Ord.	10	9	10	17 — 18	..	5 11 1
Do. 6 % Cum. Pref.	10	6	6	12⅜ — 13⅜	..	4 7 8
Do. 5 % Deb.	Stock	5	5	116 —120	..	4 7 4
Do. 4½ % Second Deb.	100	4½	4½	100 — 103	..	4 8 1
County of London, Ord.	10	6	7	11⅜ — 12⅜	..	5 13 2
Do. 6 % Pref.	10	6	6	11⅜ — 12⅜	..	4 19 0
Do. 4½ % Deb.	Stock	4½	4½	102½—105½	..	4 5 9
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 7 5
Edmundson's, Ord.	£8	..	..	⅜ — ⅝	..	Nil
Do. 6 % Cum. Pref.	5	6	6	3⅞ — 4¼	..	7 1 2
Do. 6 % Non-Cum. Pref.	5	..	..	1⅝ — 2	..	..
Do. 4½ % First Mort. Deb.	100	4½	4½	84 — 87	..	5 3 6
Folkestone	5	6	6	4⅜ — 4¾	+ ⅛	6 3 1
Do. 5 % Cum. Pref.	5	5	5	4¼ — 4⅝	..	5 5 3
Do. 4½ % First Deb.	100	4½	4½	93 — 95	..	4 14 9

Hove	5	8	9	8¼ — 9	..	5 0 0
Kensington & Knightsbridge, Ord.	5	8	9	7⅝ — 8	..	5 12
Do. 4 % Deb.	Stock	4	4	90 — 92	..	4 7 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	76 — 80	..	5 12 0
London Electric, Ord.	3	2½	3	1⅜ — 1⅝	..	5 2 7
Do. 6 % Pref.	5	6	6	4¾ — 5⅛	..	5 17 3
Do. 4 % First Mort. Deb.	Stock	4	4	92 — 96	..	4 4 1
Metropolitan	5	4½	4½	3⅝ — 3¾	..	5 16 8
Do. 4½ % Cum. Pref.	5	4½	4½	4⅜ — 5	..	4 10 0
Do. 4½ % First Mort. Deb.	Stock	4½	4½	97 —100	..	4 10 0
Do. 3½ % Mort. Deb.	Stock	3½	3½	83 — 86	..	4 1 4
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	100 —103	..	4 17 1
Notting Hill, 6 % Non-Cum. Pref.	10	6	6	9⅝ — 10½	..	5 14 3
Oxford	5	7	7	5½ — 6⅛	..	5 11 0
St. James' and Pall Mall, Ord.	5	10	12	9⅛ — 9⅜	..	6 3 1
Do. 7 % Pref.	5	7	7	6⅝ — 7⅛	..	4 18 3
Do. 3½ % Deb.	100	3½	3½	83 — 86	..	4 1 4
South London, Ord.	4	5½	5½	2⅜ — 3⅛	..	6 10 4
Do. 5 % First Mort. Deb.	100	5	5	98 —101	..	4 19 0
South Metropolitan, 7 % Pref.	1	7	7	1⅜ — 1⅝	..	5 6 8
Do. 4½ % First Deb. Stock	100	4½	4½	94½ — 97½	..	4 12 4
Urban, Ord.	£3	Nil	..	⅜ — ⅝	..	..
Do. 5 % Cum Pref.	5	3†	4	2½ — 3 xd	..	6 13 4
Do. 4½ % First Mort. Deb.	100	4½	4½	85 — 88	..	5 12 3
Westminster, Ord.	5	10	10	8¾ — 8⅞	— ½	5 14 3
Do. 4½ % Cum Pref.	5	4½	4½	5⅛ — 5⅜	..	4 4 9

* Unless otherwise stated, all shares are fully paid. † Interim Dividend. ‡ And Funded Certs.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued.)*

ELECTRICITY SUPPLY AND POWER—COLONIAL AND FOREIGN.

NAME.	Stock or Share.	Dividends for		Closing Quotations April 14th.	Rise + or Fall —	Present Yield p.c.
Adelaide, 6 % Pref.	£	6	6	5 — 5¼	..	£ 5 14 3
Calcutta, Ord.	£	8½	5†	7⅞ — 8	..	5 6 3
Do. 5 % Pref.	£	5	5	5 — 5¼	..	4 15 3
Calgary Power, 1st Mort. Bds.	100	5	5	90½ — 92½	..	5 8 0
Canadian Gen. El. Com.	$100	7	8	111 —115	..	6 16 9
Do. 7 % Pref.	$100	7	7	119 —124 xd	..	5 9 5
Cordoba Lt., Power and T., Ord.	1	5	..	⅞ — ⅞	..	7 12 0
Do. 5 % Deb.	100	5	5	87 — 90 xd	..	5 11 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	6	6	87 — 89	..	6 14 10
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	91 — 94	..	5 6 5
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	93¼—95½	..	5 4 9
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	..	1/16— 3/32	..	Nil
Do. 6 % Pref.	£	6	6†	3/32— 1/32	..	10 11 10
Kaministiquia Power, 5 % G. Bs.	$500	5	5	102 —104	..	4 16 2
Madras, Ord.	£	Nil	..	1/32— 1/32	..	Nil
Melbourne, 5 % 1st Mort. Deb.	100	5	5	103¾—106¾	..	4 14 0
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	65 — 70	..	7 2 10
Mexican Lt. & Power, Common	$100	4	4†	38 — 43	—4	..
Do. 7 % Cum. Pref.	$100	7	7	75 — 80	—3	8 15 0
Do. 5 % 1st Mort. Gold Bds.	..	5	5	78 — 83	..	6 0 6
Do. 5 % 2nd Mort. Bonds	100	5	5	65 — 69	..	7 4 11
Monterey Rly., Light & Power, 5 % 1st Mort. Deb.	* 100	1919. 5	1913. 5	54 — 59	..	£ s. d. ..
Montreal, Lt., H. and Power	$100	9	10†	228 —233	—2	4 5 10
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5a	5a	10 — 20	..	..
River Plate, Ord.	Stock	10	..	245 —255	..	3 18 5
Do. 6 % Non-Cum. Pref.	Do.	6	6	103 —108	..	5 11 1
Do. 5 % Deb. Stock	Do.	5	5	101 —103	..	4 17 0
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	5½	6	136 —140 xd	..	4 5 9
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 7
Do. 4½ % Per. Deb.	Stock	4½	4½	101 —103	..	4 7 8
Toronto Power, 4½ % Deb.	Do.	4½	4½	95 — 97	..	4 12 9
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	87 — 89	—1	5 12 4
Victoria Falls Power, Pref.	1	6	6	33/32— 35/32	..	7 13 4
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	6	6	102 —104	..	5 15 5

MANUFACTURING COMPANIES.

Aron, Ord.	£	7	..	33/32— 37/32	..	8 5 0
Do. 6 % Pref.	£	6	6	3/32— 4/32	..	6 17 2
Babcock & Wilcox	£	16	16†	2¹⁵/₁₆— 3¹/₁₆	—1/16	5 4 5
Do. Pref.	£	6	6	1¹⁵/₁₆— 1¹⁷/₁₆	..	4 8 6
British Aluminium, Ord.	£	..	5	1¹⁵/₃₂— 1¹⁷/₃₂ xd	..	4 11 4
Do. 6 % Cum. Pref.	£	6	6	3¹³/₃₂— 3¹⁵/₃₂ xd	..	6 8 9
Do. 5 % Prior Liens Debs.	100	5	5	96 — 99	..	5 1 0
Do. Deb. Stk.	100	5	5	88 — 93	..	5 7 6
B.I. & Helsby Cables	£	10	13	9½ — 9⅝	..	6 13 4
Do. Pref.	£	6	6	5⅝ — 6⅝	..	4 14 1
Do. Deb.	100	4½	4½	101 —104	..	4 6 9
British Thomson-Houston, Deb.	100	4½	4½	92 — 94	..	4 15 9
British Westinghouse, Pref.	£	Nil	5	1 5/16— 1½	—3/32	6 13 4
Do. Deb.	100	4	4	73 — 75	..	5 6 8
Do. 6 % Prior Lien	100	6	6	100 —103 xd	..	5 16 6
Browett, Lindley, Ord.	£	1	..	2/- —3/-	..	Nil
Do. Pref.	£	1	..	8/- —8/6	..	Nil
Brush, 7 % Pref.	£	2	Nil	0 — ¼	..	Nil
Do. 5 % Prior Lien Deb.	100	5	5	80 — 85	..	5 17 8
Lo 4½ % Deb.	100	4½	4½	42 — 46	+3	9 15 8
Do. 4½ % Second Deb.	100	4½	4½	26 — 30	+3	15 0 0
Callender's Cable	£	15	5†	11½ — 12½	..	6 0 0
Do. Pref.	£	5	5	5 — 5¼	..	4 16 5
Do. Deb.	100	4½	4½	97 —100	..	4 10 0
Castner-Kellner	£	20	22½	2⅜ — 2⅝	+ ⅛	..
Do. Deb.	100	4½	4½	104 —107	..	4 4 1
Crompton & Co., Deb.	100	5	5	83 — 85	..	5 17 8
Dick, Kerr	£	Nil	..	⅜ — ⅝	..	..
Do. Pref.	£	1	6	1¼ — 1⅜	..	7 7 8
Edison & Swan, A, £2 paid	£	Nil	..	0 — ⅛	—1/32	Nil
Do. fully paid	£	Nil	..	1 — 1½	..	Nil
Do. 4 % Deb.	100	4	4	58 — 62	..	6 9 1
Do. 5 % Second Deb.	100	5	5	62 — 67 xd	..	7 9 1
Electric Construction	£	5	..	3/32— 3½	..	7 12 6
Do. Pref.	£	1	7	1 3/16— 1 5/16	..	6 11 7
Greenwood & Batley, Pref.	£	10	7	6¾ — 7¼	..	9 18 2
Do. Deb.	100	5	5	92 — 94	..	5 6 5
General Electric, 6 % Pref.	£	10	6	10½ — 10⅝	..	5 14 3
Do. Deb.	100	4	4	84 — 88 xd	..	4 11 0
Henley's, Ord.	£	15	20	13½ — 14½	..	6 17 11
Do. Pref.	£	4½	4½	4 3/16— 5 1/16	..	4 9 0
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
India-Rubber, G. & T.	£	10	7½	10½ — 11½	..	6 10 5
Do. Pref.	£	10	5	8⅝ — 9⅛	..	5 5 3
Telegraph Construction	£	12	20	36 — 38	..	6 6 7
Do. Deb.	100	4	4	98 —100	..	4 0 0
Willans & Robinson, 6 % 1st Mort. Deb.	100	4	4	64 — 68	..	5 17 8
Do. B 4 % Cum. Pref.	100	..	..	50 — 55	..	..

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	£	4½	4½	5⅝ — 6½	..	7 4 0
Do. 5 % Deb. Red.	Stock	5	5	94 — 97	..	5 3 0
American Telep. & Teleg., Cap.	$100	8	8	123 —126	+1	6 7 0
Do. Collat. Trust	$1000	4	4	91 — 94	..	4 5 3
Anglo-American Telegraph	Stock	3	3	64 — 67	..	4 9 7
Do. 6 % Pref.	Do.	6	6	109 —110	..	5 9 4
Do. Def.	Do.	30/-	30/-	23½ — 24½	+ ½	6 3 9
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	102 —104	..	4 16 2
Chili Telephone	£	8	..	7⅜ — 7⅝	..	5 5 0
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	80½ — 82½	..	4 17 0
Cuba Telegraph	£	10	6†	8¾ — 9¼	..	6 3 1
Do. 10 % Pref.	£	10	10	15⅜ — 16⅝	..	5 19 5
Direct Spanish Telegraph, Ord.	£	4	4	3¾ — 4	..	5 0 0
Do. 10 % Cum. Pref.	£	10	10	7⅜ — 8	..	6 5 0
Direct United States Cable	£	10	4	4 — 7⅛	..	5 12 4
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	97 — 99	..	4 10 10
Eastern Telegraph, Ord. Stock	Stock	7	7	132 —135	..	5 3 8
Do. 8½ % Pref. Stock	Do.	8½	8½	77½ — 79½	..	4 8 1
Do. 4 % Mort. Deb.	Do.	4	4	96 — 98	..	4 1 8
Eastern Extension	£	10	7	12⅜ — 12⅝	..	5 8 0
Do. 4 % Deb.	Stock	4	4	94½ — 96½	..	4 3 0
Globe Telegraph and Trust	£	10	6†	11½ — 11⅝	— ⅛	5 3 1
Do. 6 % Pref.	£	10	6	12½ — 13	..	4 12 4
Great Northern Telegraph	£	10	20	32 — 34	..	5 17 8
Indo-European Telegraph	£	25	5†	58 — 60	..	5 8 4
Mackay Companies Common	$100	5	5	85 — 88	..	5 13 8
Do. 4 % Cum. Pref.	$100	4	4	70 — 73	..	5 9 7
Marconi's Wireless Telegraph	£	20	20	3⅝ — 3⅞	—1/16	5 16 4
Do. 7 % Cum. Partic. Pref.	£	17	..	2 1/16— 2 3/32	— ⅛	5 15 8
Monte Video Telephone, Ord.	£	6	6	1 13/16— 1 15/16	..	6 8 0
Do. 5 % Pref.	£	5	5	⅞ — 1	..	5 14 8
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	100 —101	+ ½	4 9 0
Oriental Telep. and Elec.	£	10	8†	2½ — 2⅝	..	4 4 3
Do. 6 % Cum. Pref.	£	6	6	1 5/16— 1 7/16	..	4 11 5
Do. 4 % Red. Deb.	Stock	4	4	87¾ — 89⅜	..	4 9 5
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	98 —100	..	4 0 0
Reuter's	£	10	10†	8 — 9	..	11 2 2
Submarine Cables Trust	£	Cert.	6	127 —130	+1	4 12 4
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	98 —100	+1½	4 10 0
United River Plate Telephone	£	8	6†	6⅜ — 6⅞	..	5 16 5
Do. 5 % Cum. Pref.	£	5	5	5¼ — 5⅜	..	4 9 0
West Coast of America	£	2½	2½	1 15/16— 1 31/32	..	4 8 0
Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4	4	96 — 99	..	4 0 10
West India and Panama Teleg.	£	1½	1½	2⅜ — 2⅝	..	4 15 3
Do. 6 % Cum. 1st Pref.	£	6	6	9⅝ — 10⅛	..	5 18 5
Do. 6 % Cum. 2nd Pref	£	6	6	9 — 9½	..	6 6 4
Do. 5 % Debs.	100	5	5	97 — 99	..	5 1 0
Western Telegraph, Ltd.	£	7	7	13⅜ — 13⅝	+ ⅛	5 1 11
Do. 4 % Debs.	Stock	4	4	95⅜ — 97⅜	..	4 2 1
Western Union 4½ % Fdg. Bonds	$1000	4½	4½	95 — 98 xd	+1	4 11 10

* Unless otherwise stated all shares are fully paid. † Interim dividend. *a* Paid in deferred interest warrants.

Bank rate of Discount 3 per cent., January 29th, 1914.

A new Cinematograph Projector.—A new type of moving film projector, which has been particularly designed for lecture and educational purposes by Messrs. L. Kamm & Co., the patentees, was recently demonstrated at the Polytechnic, Regent Street. The apparatus embodies a device by which the film can be stopped, when required, without the danger of a celluloid film catching fire or of the gelatine coating melting in the case of a non-flam film, and thus allows time for the lecturer to demonstrate any special feature of the picture. This result is obtained by using a special form of shutter, situated behind, and in close proximity to, the film, each shutter blade being formed of two or more fan-shaped sectors. The shutter blades not only intercept a large amount of heat in revolving past the gate, but also blow air on to the film and keep the gate cool as well. The shutter is driven from the main projector drive and clutched to the film driving mechanism, and the clutch can be operated either by hand, or by an electromagnet controlled from a distance by the lecturer, this, of course, stopping the film, while the shutter continues to blow air on to it. Incidentally, the numerous and lengthy sub-titles which occupy a considerable amount of film can be replaced with a very short title section. The arrangement will undoubtedly add to the value of the moving-picture demonstrations for many purposes.

REVIEWS.

Application of Power to Road Transport. By H. E. Wimperis, M.A., M.I.E.E. London: Constable and Co., Ltd. Price 4s. 6d. net.

The electrical engineer, in perusing the series of six lectures delivered by Mr. Wimperis at the Finsbury Technical College in 1913, which form the basis of the work under review, naturally turns first to learn something of the author's views on the subject of the application of electric power to road transport.

Up to the present time, as the author says, "little has been written upon this subject," and "there is a paucity of published experimental data to serve as a substantial basis for design." But of petrol-electric systems more is known, and Mr. Wimperis goes into details of the Tilling-Stevens, Thomas and Macfarlane-Burge systems, details that are presented in a handy form for comparative purposes. Of electric road vehicles pure and simple there are, of course, only two main types—the storage battery vehicle and the trolley omnibus. Of the former we are told that 20,000 are in use in the United States—a remarkable contrast to the undeveloped state of the electric vehicle industry in this country, though possibly the advent of the Edison battery may improve our position. Mr. Wimperis shows that with energy at ½d. per unit an electric vehicle weighing 29 cwt. can be run for 0.167d. per ton-mile, the best figure for a corresponding petrol vehicle being 0.25d., which demonstrates that the electrical vehicle should be able to hold its own as far as power costs are concerned.

Trolley omnibuses, we agree, have not been running long enough to enable complete comparisons to be made with existing electric tramways. The system certainly does not present any special problems of scientific interest, since its electrical side is so similar to that of the electric tramcar, which has already been brought to a high state of perfection.

As the inventor of the accelerometer which bears his name, and which is adequately described, Mr. Wimperis has much to say on the subject of road tests and how these should be carried out. He suggests an ingenious method of testing on the road a car's potential hill-climbing powers in level country where no road undulations are available.

Much of the volume is of an elementary and historical character—we are reminded again of Macaulay's moralizing on the advantages of intercommunication of peoples—but nevertheless it is well and interestingly written, and is quite up-to-date, details being given of recent official trials conducted by the Technical Committee of the Royal Automobile Club.

The Practical Metallography of Iron and Steel. By John S. G. Primrose, A.R.T.C., A.I.M.M. Manchester Scientific Publishing Company. Price 3s. net.

Metallography is one of the newest sciences, and one which is of immense practical value. So accustomed have we become to judging metals by their structure as revealed by the microscope instead of by fracture only, that it is difficult to believe that twenty years ago the science of metallography was practically unknown.

Every steel works, and most important engineering works, nowadays employ skilled metallographists, whose business it is to examine under the microscope specimens of the metal produced or worked, and generally to obtain by photographic means a permanent record of the metal examined.

How such practical work is best undertaken, in the light of the latest researches, is well explained by Mr. Primrose in the book under review, with the aid of a wealth of microphotographs, of the excellence of which there will be no reason to doubt when it is said that the majority of these are by that pioneer in the world of metallography—Dr. John Edward Stead. The name of the latter scientist we note for the first time to be used to form the coined word "Steadite," meaning the eutectic of iron phosphide and iron.

Mr. Primrose's chapter on the heat treatment of iron and steel is very helpful, for so much depends nowadays on the exactness of the thermal treatment of metals, many of the newer alloy steels being ruined if the heating, quenching, and reheating are not done with absolute precision.

We do not remember having seen the subject of the pathology of iron and steel dealt with so fully before, and commend this feature of the present work. It would be desirable if the specimens examined by Mr. Primrose could be used to form the nucleus of a Pathological Museum of Iron and Steel similar to that established for the non-ferrous metals by the Institute of Metals.

In an Appendix, the author deals with the latest metallographic apparatus, but we would suggest that in future editions the advertisements appearing opposite the text in this section should be placed elsewhere. It is quite unusual in a work that has claims to be of a scientific character for advertising matter to be interleaved as has been done by the publishers of Mr. Primrose's otherwise commendable little handbook.

Electrical Meters. By Cyril M. Jansky, B.S., B.A. London: Hill Publishing Co. Price 10s. 6d. net.

Why do all the good books come from America? We do not wish to say that all the books that come from America are good, even when they are technical; but of useful books, serious contributions to technical literature, by competent and responsible authors, there is decidedly a boom over there and a slump in this country. So, at least, it appears to a fairly busy reviewer.

The present work is by the Associate Professor of Electrical Engineering in the University of Wisconsin, and belongs to the Engineering Science Series, prepared in the Extension Division of that University.

It may be, though we think it is not, known to our readers, that Professor Ely, of Wisconsin, delivered in May of last year, a course of six lectures at the London School of Economics and Political Science, on "The General Conception of Property in Economic Theory." The present reviewer attended these lectures, and was very favourably impressed by the clearness of exposition and grasp of the subject displayed by Professor Ely. The impression created by Professor Jansky's book is equally favourable, and we congratulate students at Wisconsin upon the presence on the University staff of two such men as these.

The book contains twenty-two chapters, and deals in the most exhaustive manner with the principles involved, and with the practical application of those principles. To some of the chapters the author appends a summary, with examples. This and an occasional lapse into the class-room manner are the only apparent signs of his professorial capacity—that is, that the book is primarily intended for students. Take, for example, p. 295, where he suddenly asks the question: "Can you explain this?"

In the preface Professor Jansky thanks manufacturers for supplying him with information and pictures. British manufacturers would be equally pleased to do this for British professors, but how often are they asked to do so? Much has been heard in recent years of "Co-operation in the electrical industry," and useful work has been done in this direction, with very beneficial results. Do not let

us overlook the fact that electrical engineering is a scientific profession, as well as an industry. Co-operation, therefore, is necessary between all branches; between thinkers and constructors, between educators and educated, between theoretical and practical, between scientific and commercial. And although universities and colleges could not afford, and would never find it desirable, to buy a complete range of apparatus from every manufacturer; and although manufacturers could not afford to present a complete range of goods—meters or what not—to every educational institution; still something might be done by means of a common fund, out of which a representative selection of instruments might from time to time be purchased, say at cost, and sent round for the purpose of being lectured upon and demonstrated. The teachers and students would gain up-to-date knowledge, and the manufacturers—well, a fine advertisement, if nothing more.

To return, however—of course everything described, with very few exceptions, is American. We think Professor Jansky might usefully have referred a little more copiously to British and European practices. We have Weston voltmeters and ammeters, but no mention of Elliott Bros.; a woodcut of, and dissertation on, the Siemens dynamometer, but no mention of Siemens, either in this or any other instrumental connection; full descriptions of everything, obsolete or not, that the General Electric Co. has ever put forward, but no mention of the work of the British Thomson-Houston Co., or of the A.E.G., which has, in our opinion, frequently resulted in material improvements; a paragraph on the obsolete and almost forgotten Edison zinc-in-zinc-sulphate electrolytic meter, and—welcome exception to our complaint—a page or so on the Bastian, but no mention of the fifteen years of work that Reason has done in the electrolytic world; a description of the "maxicator," but nothing about Merz.

For Americans, these may not be serious matters, but for author and publishers, such points tend to restrict sales in this country, though the book is well worth reading in spite of these omissions.

We are glad to note that Professor Jansky is strict in his use of words. A meter for measuring the supply of electricity is not a "wattmeter," nor even a "recording wattmeter," although responsible firms have sent out meters bearing these descriptions. Moreover, electrolytic meters are always ampere-hour meters. although frequently misnamed watt, or even watt-hour, meters. Again, he is particular to point out that the percentage accuracy of an instrument should be given with reference to true value, not to indicated value. If the latter method is used, a meter indicating 25 per cent. of the load upon it is described as 300 per cent. slow, which means, clearly enough, that you must add to the meter's indication three times the value of that indication, or that the error is three times the reading. It is much better, however,to give the error as 75 per cent., meaning that that proportion of the true value is not shown.

In connection with supply meters, we observe, on p. 339, the statement: "Other things being equal, the watt-hour meter whose torque-weight ratio of moving element is largest, is the best meter." The saving clause, "other things being equal" just redeems this from being a mere reiteration of a parrot-like tag which was, some years ago, repeated *ad nauseam*. The form of the bearing, and the moment of inertia of the rotating part, are of more importance than weight, as such; and torque must bear a reasonable relation to losses, as well as to weight. We have no hesitation in saying that a great deal of nonsense has been talked on this point by manufacturers, with results that they now rue.

In the consideration of sources of error, reference is made to pen friction in recorders. This leads us to wonder if the intermittently-recording graphic meter shown, we believe, at the 1905 Olympia Exhibition, is still on the market. We must not fail to mention the—to us—new magneto-constriction type of ammeter, in which the current is indicated by the mechanical pressure induced by passing a current through mercury. If this instrument is known in this country, or on the continent of Europe, we shall be grateful for reference to it.*

Much more could be said, but space forbids. The few errors are typographical and immediately obvious. The book is properly indexed and methodically divided. It has interested us very much, and we congratulate the author upon it.

LEGISLATION? OR SAFETY FACTOR? IN MINING WORK.

By "COLLIERY ELECTRICIAN."

The Senghenydd Inquiry is now over, resulting in the usual clamour for further legislation.

It need hardly be pointed out that those who agitate for further legislation have little practical knowledge of mining work, especially of one section, which is a special branch to itself. The technicalities of electricity are as a sealed book to them, and as they do not understand it, they say "Throw it out." They have never considered that the safety of their members, numbering nearly 1,000,000, depends upon the competency of the electrician in charge, nor even considered the point of having a mining electrical expert permanently attached to their Representation Committee, but remain quite satisfied that an electrician is only worth a minimum wage of about 5s. per day net, equal only to a labourer's wage.

Take the evidence at the Senghenydd Inquiry on February 5th. Should such an electrician be allowed to be at a mine? It is not very complimentary to men who are competent electricians, to say the least of it.

On February 6th it was asserted that the signal bells rang continuously for three or four days after the explosion, upon which Mr. Smillie commented: "what a voltage there must have been!"

What a splendid advertisement for "Diana" cells if the bells were ringing continuously for three or four days on short or closed circuit!

Legislation may be very good when brought about by practical technical men, but what did the last revision of Electrical Rules bring forward:—

1. The appointment of a competent electrician to take charge of the plant and to be in daily attendance at the mine.

2. Increase in voltage on signal wires from 15 to 25 volts.

As regards item 1, the old rules stipulated a competent person should be on duty at the mine during the whole time the plant is running, and where 200-H.P. was delivered underground, a competent person should be on duty underground in addition to one on the surface.

Respecting item 2, it is now considered dangerous to use more than 9 volts because gas can be ignited with 11.9 volts, yet it has been proved conclusively that methane can be fired with the cell of an electric safety lamp at 3 volts only. It is now compulsory to have a water-gauge in fan houses. What use is this for an electrically driven fan run at a constant speed? Would not a recording ammeter be more indicative of faulty ventilation? Is the cry for mining electric safety lamps meant for greater safety or for better illumination at the coal face to enable the collier to increase his earnings? There is no doubt, of course, of its fulfilling both points, but

*See Elec. Rev., Sept. 24th, 1909, p. 505, and April 8th, 1910, p. 546.

which is foremost in the minds of the agitators? The extra 9d. per day seems to answer this. Any amount of agitation will not stop the collier from putting his pick point into the glass of an electric safety lamp or into the shield and gauze of an oil lamp or opening the magnetic lock of his lamp with a magnet of his own, or do away with his contempt of dangers underground.

If legislation is necessary, let it be in the proper direction.

If a manager, under-manager and other officials have to prove their competency by examination, why not the mechanical engineer and electrical engineer or electrician? What is necessary in maritime work should be necessary in mining work. The men who profess to know ask for one inspector for every 5,000 men, but say nothing as to one electrical inspector for 1,000,000 men or over 4,000 mines.

Taking into consideration the large amount of electricity used in mines to-day there is every scope for an electrical inspector to be attached to each mining district, not to act as a policeman to work up prosecutions, as the majority of present inspectors are doing to-day, but as advisers to colliery owners, managers, etc. in the first instance, and as policemen afterwards, if necessary.

What good would a workman's inspector be to discuss electrical matters with a technical electrical engineer who has specialised in mining work?

Perfect *ventilation* and perfect *insulation* are *the* factors for immunity from explosions or accidents from electrical causes, and any pit to-day should be absolutely safe if there is efficient ventilation. Why be satisfied at so many cubic feet of air per man? Why cannot the pit underground be as well ventilated as the underground railways in London? Stronger air currents will dilute gas to a non-explosive mixture and tend to carry away a lot of the dust which accumulates, and make underground workings as safe as an open-air quarry.

One of the objects of the Association of Mining Electrical Engineers is "To consider means for minimising the risks attending the application of electricity to the industry of mining and to promote the adoption of approved methods and devices tending to increase safety."

The founders were practical men who realised that a great safety factor lay in the determining first of the qualifications of those in charge of mining plants by examination, but apparently the last Commission were too shortsighted to see it. A Home Office certificate would relieve the manager of a lot of worry as to the competency of the electrician under him and make the electrician realise his responsibilities and official position all the more, especially if more visits were paid to collieries by *electrical* inspectors.

The Association hold their own examinations, certainly, but what good are the certificates granted except for framing? Even Mr. R. Nelson, H.M. Electrical Inspector of Mines, considers the examinations too academic, but does not offer suggestions as to Home Office examinations or certificates, as is compulsory with other mining officials.

For the benefit of the electrical trade and those engaged in connection with it, the Council of the A.M.E.E. ought to show the non-technical agitators that they have interests at stake as to the safety of electricity in mines, and of underground workers, and prove by their endeavours that they are just as much alive to the necessity of further legislation if it is needed.

Mining electrical engineers in actual touch with mining work should be qualified to speak and act on behalf of themselves and members of the same profession, and it is in the hands of the members to see that these men are appointed on the Council to represent them, if they consider that the Council is not sufficiently progressive at the present time.

Compulsory certification of mining electrical engineers or colliery electricians should be pressed forward and insisted upon. This would wipe out a lot of ignoramuses at present in charge of plants, tend to greater safety, give more confidence as to the safe working of electricity in mines, and elevate the status of those engaged in such applications, and, finally, wipe out of the minds of the non-technical section of the mining industry the prejudice existing against the use of electricity in mining work.

This procedure would fulfil the question of perfect *insulation* as a chief factor of safety and the ques- to the colliery manager to come under his jurisdiction of perfect *ventilation*, of course, should be left tion.

HIGH-SPEED BEARINGS.

By GERALD STONEY, F.R.S.

(*Abstract of a paper read before the* N.E. Coast Institution of Engineers and Shipbuilders, *March 27th*, 1914.)

Tests show that so far as friction is concerned it is not well to use a large shaft and a long bearing, but experience shows that for high speeds and heavy loads long bearings are necessary, and they have also to be large to avoid vibration and critical speeds, and the risk of fracture due to vibration. To avoid this latter danger the bending stresses have to be kept to a figure which would be considered very low in ordinary practice, as there have been several cases of fracture of shaft ends. If the pressure is too high or the oil is too thin a bearing may run all right so long as there is no vibration, but if vibration occurs the oil film may be driven out and seizing take place. This is especially liable to happen with the shafts of electrical machinery, such as the armatures of dynamos and rotors of alternators, where there is always a liability to vibration occurs the oil film may be driven out and seizing that much lower pressures are advisable in such cases than in those of turbine rotors, which from their construction are not, as a rule, so liable to go out of balance.

This effect is reduced in very high-speed shafts, above, say, 2,000-r.p.m., by the use of the well-known Parsons flexible bearing, where there are two or more tubes outside the bearing bush with a small clearance between them in which the viscosity of the oil tends to damp out vibrations. In turbine work, a rule much used for deciding the size of bearings has been that the product of the speed by the pressure should not exceed a certain figure, but it is doubtful whether this rule is of much value, as it really assumes greasy friction and not perfect lubrication. In land work a product of 5,600 has rarely been exceeded, or 75 lb. per square inch at 75 feet per second. At lower speeds, higher pressures are used satisfactorily, as, for example, at about 35 feet per second a pressure of 130 to 150 lb. per square inch is admissible.

In a discussion on Prof. Christie's paper before the American Society of Mechanical Engineers in 1912, Hodgkinson stated that speeds of 80 feet per second and 100 lb. per square inch were commonly employed in America, and where there is no risk of heavy vibration there does not seem any reason why higher pressures should not be used. It has to be remembered that the heat to be carried off does not increase with the pressure, and that the real danger lies in the possible breaking down of the oil film by excessive pressure or vibration.

The temperature of the oil is limited by its loss of viscosity at high temperature, and by its liability to carbonise and oxidise and thus cause deposit in the pipes, oilways, etc. In land practice temperatures of 120 to 140° F. are common, but it is not well to go above 150 or 160° F., as most oils seem liable to oxidise and cause deposit above this temperature. At about 250° F. most oils cease to lubricate, as their viscosity becomes too low.

The friction is approximately inversely proportional to the temperature measured from freezing point, but after a certain temperature the friction rapidly increases and seizing takes place, due to the loss of viscosity.

In all high-speed bearings artificial means have to be used to carry off the heat, radiation from the bearings not being sufficient. The general plan is to have such a flow of oil through the bearing as to cause the heat generated to be carried away without an undue rise of temperature. Water-jacketing the bearings has been used in some cases, but it is not as satisfactory in general as the plan of supplying sufficient oil to carry off the heat. Oil coolers have therefore generally to be provided to cool the oil.

In some cases also the oil is circulated round the outside of the bearing in suitable passages so as to assist in cooling it, and this is probably necessary in the case of very large bearings running at high surface speeds. The heat to be removed is not only that caused by friction but also that caused by conduction from the steam; on the other hand the bearings near the condenser are cooled by the exhaust steam and heated by the gland steam. From Lasche's tests the heat produced in bearings running at a temperature of about 122° F. is that due to a

shear of the oil film of about 0.46 lb. per square inch of the projected area, and this gives as the B.Th.U. per hour :—

$$B.Th.U. = 2.1\ d.l.v.$$

where d is diameter of bearing in inches; l is length of bearing in inches; v is surface velocity in feet per second.

The constant varies inversely as the temperature above freezing point.

It may be taken that this is approximately the heat that has to be carried off by the oil. Taking the specific heat of oil to be 0.31 and allowing a rise of 10° F. in the oil we require 20 lb. or about one-third of a cubic foot of oil per hour per square inch of projected bearing surface when the surface speed is 30 feet per second, and 40 lb. or two-thirds of a cubic foot of oil per hour with a surface speed of 60 feet per second. In practice these quantities are often increased by from 30 to 50 per cent. to allow for the unequal distribution of oil between

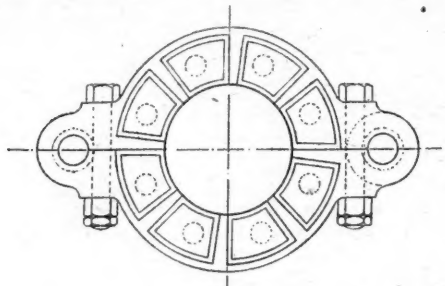


Fig. 1.

the bearings and to ensure that there is no undue heating, also in some cases to allow for the flow of heat from the steam.

Thrust bearings are generally of the usual collar type, with the bottom and top halves separately adjustable to take up end play, and in land turbines, which are practically balanced, the pressures are very low, never exceeding 20 lb. per square inch. There are no tests available as to the friction of such bearings, but it is probable that it is fairly high, as perfect lubrication is difficult to attain, and as an approximation the total area, that is the area of the top and bottom halves together,

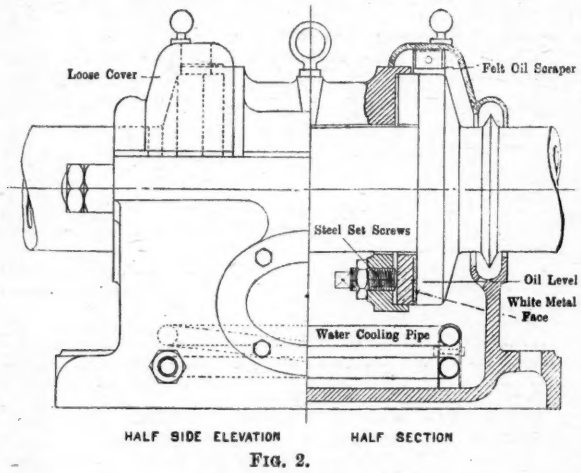


Fig. 2.

might be added to that of the main bearings in estimating the quantity of oil required and the surface of the oilcooler. Such bearings have generally a high co-efficient of friction, owing to the low pressures employed, since, as it is impossible for a wedging action to take place and thus admit the oil, such as occurs in the case of journal bearings, the lubrication is rarely perfect. Michell in 1905 devised a thrust bearing which would admit of perfect lubrication. In this thrust bearing there are segmental blocks pivoted at the theoretical centre of pressure, which is about 0.6 of the length from the leading edge. By this device perfect lubrication is attained and pressures up to 1,500 lb. per square inch can be safely carried at high velocities with a consequent reduction of the co-efficient of friction to about one-sixtieth of what it is in an ordinary thrust bearing. Another advantage is that the end play in the thrust bearing can be greatly reduced.

The same idea has been further developed by Sir Charles Parsons, in patent 8,266 of 1912, where the blocks are centrally pivoted, and it has been found that in cases where the pressure comes on gradually this works equally well in practice, and has the advantage that the shaft may run in either direction without the complication of shifting the point of support.

These principles have also been applied to journal bearings by Michell and Sir Charles Parsons, enabling greatly increased pressures to be used with a resultant reduction of the co-efficient of friction and also a large reduction in the length of the bearings, and thus of the whole plant. The reduction of friction may in some cases reduce the consumption of steam between 1 and 2 per cent. in a turbine plant.

Figs. 1 and 2 show a thrust bearing of the Michell type designed by Mr. H. T. Newbigin for 23,000 lb. thrust at 550 to 570 revolutions per minute. The co-efficient of friction of such a bearing may be from 0.0008 to 0.003, and for such a pressure as 500 lb. per square inch may be safely taken as about 0.002, or say one-tenth to one-fifteen of that of an ordinary thrust bearing.

The Westinghouse Company of Pittsburgh made an interesting set of tests on such a thrust bearing for a steam turbine, the pressure being varied by throttling the balancing pipe to the dummy piston. The following are the particulars of this bearing :—

Outside diameter of collar	...	4¾ inches
Inside diameter of collar ...	...	2¾ ,,
Number of pivoted blocks ...	...	10
Total area of pivoted blocks	...	10.4 square inches
Revolutions per minute ...	...	3,470
Mean surface speed	...	54 feet per second

The blocks were of steel faced with white metal 1-16 in. thick, and were pivoted behind their centre of area, and with all the blocks in use 1,010 lb. per square inch was carried without heating. The number was first reduced to four blocks, and then to two, the corresponding pressures per square inch being respectively 2,620 and 5,420 lb. per square inch, which were carried without difficulty. The limit of pressure with such a bearing is the flowing of the white metal and not the failure of the lubrication; with pressures of 500 lb. per square inch there is an enormous margin of safety, and it is probable that three times this pressure will be found quite safe in practice.

CURRENT-LIMITING REACTANCES ON LARGE POWER SYSTEMS.

(*For abstract of paper read before the* Institution of Electrical Engineers, *see p.* 609).

Discussion at Birmingham.

Mr. F. H. Clough said that where large power supply undertakings existed, it was essential to take all reasonable means to ensure the continuity of this supply and the protection of the apparatus connected to the system. The use of large reactances between sections of the bus-bars might be considered as a semi-isolation; by properly proportioning these reactances the result of a short circuit or other breakdown could be limited to the section in which it occurred, but at the same time power might be supplied to any particular section from the adjacent ones so as to maintain the continuity of supply on the generators and also in the outgoing feeders, protected the that particular section. The use of reactances in series with apparatus rather than maintained the continuity of supply. Small generators could undoubtedly be designed so that they did not need reactances to protect them. For large generators they could be dispensed with provided close voltage regulation was not necessary, and in most cases it was not necessary. If a serious fault occurred in the winding of an alternator, it was usually sufficient to damage the machine very seriously, even if it were running by itself, and therefore any additional flow of current only made the burn-out more complete. When one looked at Fig. 1 (see page 610) and realised that wherever one reactance appeared on the diagram there must be three—one for each phase—one realised what a large space these must occupy, and wondered whether they could not be avoided. So far as the feeder was concerned it should be possible to make use of the Merz-Price and Merz-Hunter devices.

Mr. R. A. Chattock said that the importance of this paper could hardly be over-estimated in view of the altered conditions that had now to be met in the design and operation of large power houses. Reliability of supply must be one of the first considerations. It had been evident for some time that under certain conditions of operation, even the largest oil switches were damaged when they opened, and even on occasion failed to break the circuit, due to the enormous amount of energy that was concentrated on the bus-bars. This amount of energy was year by year growing larger, and it was evident that now the limit of safety in the switchgear had been reached. The proposal to sectionalise the switchgear by current-limiting reactances so that the energy to be dealt with by the switches now available might be kept within the limits of easy and safe control was one that would increase enormously the reliability of the supply. The chief objections to the use of reactance appeared to be the lowering of the power factor and the interference with the regulation of the voltage. A low-power factor could be met by designing the generators to supply the wattless current required and by providing for greater energy of excitation. This was the way in which one had to pay for the greater reliability of supply. The interference with the regulation was a more serious question. The balance of the load between sections must vary from hour to hour, and the constant adjustment of the voltage on

the various sections of a large system, required by the insertion of reactances between them, must be a very difficult operation. The authors did not say much about this. Modern turbo-alternators usually had an internal reactance of about 12 per cent.; would they recommend this to be reduced and some of it put outside the generator, and did they consider that 12 per cent. total reactance would give sufficient protection? The point raised with reference to short-circuiting the bus-bar reactances through sub-station bus-bars, by means of feeders connected to different sections of the main bus-bars, could be met by dividing the sub-station bus-bars and inserting reactances between these sections. The possibility of overloading feeder cables by the angular displacement of the voltage was very undesirable and should certainly be guarded against.

Dr. Kapp thought that where feeder cables were joined by a ring main it would be advisable to have choking coils not only at the home end of each feeder as shown in the paper, but also at the far end. Such a precaution seemed to him unnecessary where the feeder was not a cable, but an overhead line, the inductance of which would be comparable with that of a choking coil; at any rate at the far end it would not appear to be necessary. Constructing the alternator so that the armature should contain a large amount of inductance was not practicable. One could not get high inductance without at the same time getting an unduly large armature demagnetising effect. External inductance would not worsen the regulation to so large an extent. The use of externally-applied inductances was quite compatible with good regulation, provided each generator was fitted with some kind of automatic regulator taking charge of the exciting current.

Dr. C. C. Garrard said that the introduction of reactances entailed a very considerable increase in complication of the lay-out of the generating station, but continuity of supply for public electricity supply stations was becoming of more and more importance every day. Was it not possible to construct turbo-alternators nowadays which would withstand dead short-circuits? It seemed that a solution of the problem of generator protection from this point of view might be attained. Another question was whether they had reached the limit of breaking capacity of oil switches. It appeared to be wrong to put in smaller switches and endeavour to limit the short circuit; rather should they spend the money in installing the proper size switches. If reactance coils must be installed in order to safeguard the oil switches, the use of a switch which in operating first cut in the reactance and then opened the circuit was to be preferred. In this case the reactance coil was normally short circuited. The first action of the switch was to remove the short circuit on the reactance coil, and the circuit was then opened after a certain time had elapsed. The really important point of view from which to regard this subject was that of drop in voltage. The reactance coils should be installed with the one object of preventing the volts falling to such an extent, in the event of a short circuit, as to cause synchronous machinery to drop out of step. Looked at in this manner it appeared that the reactances in the feeders offered the best solution. As regarded the use of iron-clad choke coils he did not quite understand the necessity of a "straight-line" relation between the voltage and the current. Did this simply mean that the iron must not get saturated to such an extent, on a short circuit, that the permeability fell to practically that of air? Dr. Garrard further stated he would like some further explanation of the "doubling effect." If the bus-bar was sectionalised by reactance coils, then each automatic regulator would have its pilot connected to that section of the bus-bar to which its own generator was connected.

Mr. H. K. Trenchmann said that two speakers had made reference to reactance coils and patent protective systems, from which it might be understood that these performed in some measure the same functions. This was not so, as current-limiting reactances were no more able to clear a fault than to prevent one occurring. No existing protective system could succeed in opening an oil switch before the current on a bad fault had reached quite large proportions, and it was almost impossible to plan a system of reactances which would successfully limit the fault current in any part of a large network, owing to its unavoidable complexity, and to the large amount of energy which might be fed back from almost any point of it. The cost of installing a bank of reactances into the run of a set of heavy bus-bars must be very much more than that of the apparatus itself, to say nothing of the extra space required. The designers of English generating stations had had, in the past, an unfortunate tendency to cut down the space for switchgear to an uncomfortably small amount, and the designs of most English oil switches reflected that tendency. An oil switch for dealing with heavy overloads must have a large body of oil, large clearances generally, and a good head of oil above the break; and many otherwise good designs were spoiled by an insignificant quantity of oil being allowed. An oil switch possessing only a little more than five inches of break had been tested with a dead short circuit on 23,100 h.p. of generating plant at 12,000 volts and successfully opened the circuit; the damage to the contacts, etc., was not sufficient to prevent it being closed easily afterwards. If some of the additional space were given to the oil switches and suitable designs of the latter installed, the use of reactances could be considerably curtailed in even the largest systems, and, further, the capacity of stations in which they were *not used at all* could be materially raised.

Mr. E. O. Turner said that if the armature winding of an alternator were regarded as a choking coil with a partial iron circuit, its reactance could be increased by simply burying the conductors deeper in the slots. Were this done the armature reaction would not be altered, and the regulation, especially at power factors of 0.8 and below, would be much less seriously affected. He would like to ask the authors whether this was feasible in practice, and whether generators having high reactance but normal regulation were being manufactured.

Mr. Forrest said Figure 1 showed a well-thought-out method of dividing up the bus-bars of a large power station by means of current limiting reactances, so that every oil switch installed there could be depended upon to open the circuit it controlled under conditions of dead short circuit. He supported the authors in their statement that it was very desirable to feed one sub-station, from one section only of the generating station bus-bars. One reason for this was stated in the paper; a second very important reason was as follows:—Assuming that a sub-station was fed from two sections, and that the sub-station bus-bars were divided so as to keep the two sections distinct, it was possible for these two sets of bus-bars to have a considerable difference in voltage. If this difference in voltage was steady, no particular difficulty arose, but in the event of a sudden transfer of load from one section to another at the generating station, a sudden rise or fall in the voltage of one of the sub-station bus-bar sections would also result. Since the whole of the sub-station rotary converters were connected in parallel by means of the D.C. bus-bars, a sudden rise or fall in voltage on one set of machines to the extent of, say, 5 per cent., would certainly result in something very like a temporary shut-down. The introduction of reactances between the feeders and the generating bus-bars must have a beneficial effect in preventing high-frequency potential surges set up in the net-work from unduly straining the insulation of the generators and switchgear.

Mr. E. P. Hollis said that engineers in charge of the operation of power schemes had accepted the benefits which it was claimed that reactance had, but a few of them had expressed the opinion that the whole of the reactance necessary could be embodied in the machine. It should, however, be realised that external reactance had special functions which could not be performed by internal reactance. Internal leakage reactance did not protect a generator against complete destruction by a heavy influx of power in the likely contingency of the generator breaking down. Internal leakage reactance did not protect the end windings of a generator against concentration of potential due to high-frequency current entering from the line. Once leakage reactance was embodied in the machine it could not be varied in value. Separate reactance coils were susceptible of such adjustment. It was doubtful whether the path of the leakage flux of many generators with large leakage reactance was adequate to enable that path to remain unsaturated on short circuit. An objection to reactance coils was that of cost. On the debit side of the balance sheet one had to place the interest and depreciation on the cost of the reactance, together with any additional sum which deserved to be debited owing to the floor space occupied by these coils. On the credit side one had to place a number of items, the exact value of which it was difficult to appraise, but which were nevertheless of great importance:—

(1) Insurance of the generators against breakdown from external short-circuits.

(2) Insurance against breakdown of the end-turns by high-frequency surges.

(3) Insurance of the protection of the windings from complete destruction in the event of an internal breakdown.

(4) A saving due to elimination of the necessity for quickly operating switchgear.

(5) Saving due to the fact that switchgear of a lower rating is possible.

(6) Saving due to the elimination of the necessity for installing elaborate protecting devices.

(7) Saving of penalties incurred due to complete or partial breakdown of the generating station.

Mr. A. M. Taylor said that Fig. 1 represented very closely the arrangements proposed for the new power station in Birmingham. The bus-bars were to be divided up into five sections, and the output on each section was 20,000 kw. What happened outside the generating station must on no account be overlooked. If the feeders from the various bus-bar sections led to common bus-bars in different sub-stations, the reactances in the generator bus-bars would be partially or entirely short-circuited by these trunk feeders. Even if the bus-bars in the various sub-stations were divided from one another by reactances, the reactances in the generator bus-bars were still partially short-circuited by these. Then again, most systems putting down stations of the size indicated would be already in possession of a station of perhaps one-third or one-quarter the size, which had to be paralleled on to one or more of the sections of the new station. He had reproduced in the figure herewith a rough approximation of the conditions which existed in a crowded town like Birmingham, where the whole of the power supply was concentrated within a comparatively small radius of the big generating stations as distinct from, for example, the Newcastle system, where the nearest large generating centres were some six miles apart. Allowance had been made in the diagram for the effect of synchronous

machinery in the sub-stations. On the assumption that a short circuit occurred somewhere near the bus-bars "C," the admittance of the whole system into the section "C" had been worked out; it would be equal to 32 times the capacity of one bus section, or some 70,000 amperes. If they considered any one of a group of 5,000-KW. generators on one of the main bus sections, and assumed that the short circuit developed inside the winding of the generator, but near the terminals (which was, in fact, the position of greatest strain), there would be virtually no reactance between the bus-bars and the short circuit if there were no external reactance inserted in the generator leads, and there would be a tendency for this enormous current to pass through a short part of the generator

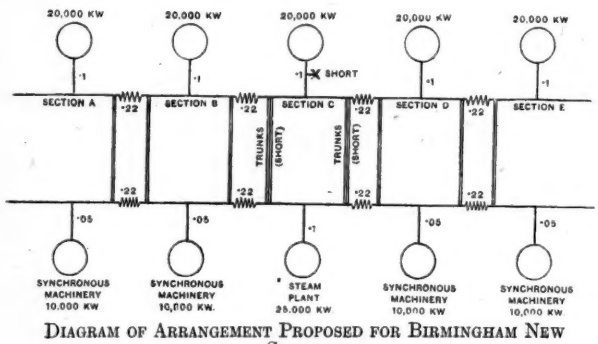


DIAGRAM OF ARRANGEMENT PROPOSED FOR BIRMINGHAM NEW STATION.

Bus-bar reactance taken at 22 per cent.
Generator ,, ,, 10 ,,
Rotary Converter ,, ,, 5 ,,
Total discharge into Section C=70,000 amperes, neglecting "doubling effect"=140,000 amperes, including it.

winding. Such a current would be 100 times normal full-load current of the generator, and it was pretty certain that the armature conductors would be instantly ripped out of their place and much more serious damage done than would obtain if the generator were merely short-circuited upon itself. If the generator was fitted, as it should be, with instantaneous protective gear, the oil switch should be open and the generator disconnected in, say, one-fifth of a second from the time of the short developing—*i.e.*, in five complete cycles. Under these conditions it was probable that any real amount of damage, due to the burning of the armature conductors, would be avoided (provided that the field circuit of the generator were also open), and, therefore, if the generator could be protected against the tremendous rush of current from *outside*, indicated above, no damage of any moment would ensue, and the cost of repairs would be comparatively trifling; damage to the field poles, which might necessitate sending the field away for repairs and be extremely costly, should be entirely saved. If, on the other hand, there were *no* external reactance in the case above considered, the conductors near the terminals would undoubtedly be ripped out of their positions in the first quarter cycle—*i.e.*, in one-twentieth of the time taken by the circuit breaker to operate—and enormous damage would be done by the time the circuit breaker had operated. The only safe way to determine whether or not reactances should be inserted external to the generators was to work out, in this way, the actual admittance to the faulty section and see whether the currents which would pass would be such as to test any part of the machine more severely than its own short-circuit current, under which it was tested at the time of purchase. If the machine was constructed with, say, an internal reactance of 8 per cent. and an external reactance of 8 per cent., and if it were short-circuited on its own internal reactance and would stand up to this, then it would be equally safe from the incoming current from the other generators as from its own short-circuit current. Another advantage secured by having an external reactance was that the external reactance might be placed far away from the generator and close up to the switchgear, and might be so arranged that there were no cable or dividing boxes between the main bus-bars and the reactance. The cable and the dividing boxes were then protected from the bus-bars as well as the machine itself. The authors suggested a 50 per cent. reactance in the various sections of the main bus-bars. When this reactance was traversed by one-half of the full capacity of one section of the bus-bars, a condition that should certainly be made, there would be a 25 per cent. drop of voltage across the reactance, and this difference of potential would be perpetuated right away to the feeding centre or sub-station. Reactances had undoubtedly come to stay, and were a prime necessity in the bus-bars of a system of 100,000 KW., but the space taken up by them was very considerable, and their effect upon the power factor of the generators was also rather serious. About two years ago he worked out a switch which would short-circuit a section, or sections, of the reactance during normal working, and when the rush of current came it would open and deflect the current through the reactance in a period of time of the order of one five-hundredth part of a second. This switch had been fully designed and all the calculations had been verified, and he was now awaiting an opportunity of performing a crucial test upon it on a large scale.

Dr. KAHN said that the necessity of using current-limiting reactances in large alternating-current supply systems had been generally recognised; on the other hand it was certainly desirable to restrict the use of this apparatus to a minimum, as apart from the additional cost such apparatus required considerable floor space and introduced an additional piece of apparatus in the already complicated system. It seemed to him that the best compromise which could be effected was to put the reactance in the bus-bars, and to use alternators with as high a reactance as possible. The reactance in the alternators themselves would then, to a large extent, take the place of reactance in the alternator circuits, and in the feeder circuits. This had at the same time the advantage of reducing the current flowing in the alternator in the case of any breakdown on the terminals, and gave a more efficient machine. In large turbo-alternators the bulk of the losses was made up by iron loss and windage loss. By increasing the reactance the flux in the machine could be decreased with a corresponding decrease in iron loss. Further, the length of the machine could usually be decreased, and the amount of cooling air required could also be decreased due to the reduction in iron loss. As the windage loss depended on the amount of air required, and on the cylindrical surface of the rotor, which could both be reduced on machines with high reactance, the windage loss of such machines would be lower than the loss in the machines with low reactance. The coarser voltage regulation of the machine due to the higher reactance was of minor importance, as machines of the size in question were invariably used in connection with automatic regulators, and the load in stations for which reactance coils were required was usually steady.

HOME OFFICE RULES FOR FACTORIES AND WORKSHOPS.

A Sub-Committee of the Switchgear Section of the BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION recently asked H.M. Electrical Inspector of Factories for his guidance towards the settlement of certain difficulties which they found to arise on the Electrical Regulations issued by the Factory Department of the Home Office (Factory and Workshops Acts, 1901 and 1907; Electrical Regulations [Form 928: February, 1910.])

Mr. G. SCOTT RAM very courteously welcomed the suggestion of discussion with him, and the Sub-Committee, during the latter part of 1913, waited upon him several times and fully discussed their difficulties. As a result, all present questions of interpretation have been set at rest, and Mr. Scott Ram's answers are now embodied in the agreed text given below which, it is understood, will be added to and form a part of the existing text of the published Memorandum on the Regulations as soon as a new edition is printed. In order to facilitate the reading of this text, the questions put by the Sub-Committee, as well as Mr. Scott Ram's answers, are given. We are indebted to the Secretary of the Association for the particulars:—

PROTECTION OF CABLES: REGULATION 2: PAGE 16.

Question 1.—It is not clear from the Regulation or the Memorandum exactly what cables should be armoured. Advice is required on this point.

Should an inter-connecting cable for coupling up two E.H.T. switchboards in one station be armoured or otherwise protected, or is it sufficient to rely upon the lead covering or, in the absence of such, the cable insulation? This applies to all cables other than those in trenches.

NOTE TO FOLLOW PAR. 1, PAGE 17.

Answer 1.—In electrical stations it is not sufficient to rely on the insulating coverings of high-pressure or extra high-pressure cables, as although the cables may be safe to handle whilst the insulating material is new, they may after a few years become dangerous to touch. Such cables should therefore be "further protected" by lead sheathing or metallic armouring or casing. Armouring or equivalent protection is required where the cables are liable to mechanical damage. The protection of tail ends of cables at generators, motors, transformers, etc., should not be overlooked.

Unarmoured cables of whatever pressure, especially those having rubber or bituminous insulation, if brought close together as in trenches or at switchboards, should be prevented from touching and where practicable should be separated by fire-resisting casings or divisions, either single or in groups, to prevent the spread of fire from one cable or group of cables to another. Where such cables pass through floors, the latter should be constructed of fire-resisting material, and where practicable the openings therein should be closed up with fire-resisting material so as to prevent the possibility of fire passing upwards.

Regulation 5.

Question 2.—Is it permissible to mount main fuses behind switch panels, provided the correct dimensions of passage-ways are adhered to? This arises particularly in respect of medium-pressure switchgear, where for economical reasons and possibly for the sake of simplification of connections, fuses are sometimes mounted behind the panels. This also involves Regulations 16 and 17 (a).

Note to follow par. 4, page 24.

Answer 2.—It is undesirable for similar reasons that main fuses should be placed behind the panels of low-pressure or medium-pressure switchboards. The blowing of a fuse, particularly under heavy short-circuit conditions, on a station switchboard, might readily lead to a short-circuit between other neighbouring conductors.

Similarly as regards small fuses for instruments, pilot circuits, etc. If placed at the back of the switchboard they should be guarded so that an arc cannot extend to other conductors, and their position as regards accessibility for purposes of renewal without danger to the attendant should be carefully considered (see under Regulation 16). Small bare wire lighting fuses have sometimes been used as instrument fuses on station switchboards, but they are quite unsuitable, as they would be unable to clear on a short circuit. A good type of enclosed fuse having ample break, or an efficient fuse of the "cartridge" type, should be used. Unless protected by a switch, all such fuses should be so constructed or mounted that they can be handled without danger of touching the live parts (Regulation 3 [c]).

Note to follow par. 1, Regulation 16, page 38.

Answer 2 (*a*).—It is particularly undesirable that main fuses should be placed behind switchboard panels. There is obviously more danger to the attendant in inspection and renewal of fuses so placed than if on the front of the board. Similarly as regards small fuses for instruments, etc., these should never be placed behind the switchboard panels in positions involving danger to the attendants, *e.g.*, close to bare bus-bars or other conductors, involving danger to the attendant in renewing them through contact with the conductors and sometimes involving risk of making short-circuits between conductors (see also, under Regulation 5, par. 2).

Area set apart for Switchboard: Regulation 15.

Question 3.—Advice is required as to exactly what is meant by an area "set apart for the purpose." Manufacturers generally have been under the impression that an electricity station in itself could be regarded as such an area, but recent recommendations by H.M. Electrical Inspector have shown this interpretation to be incorrect, and in order that switchboards proposed by manufacturers should uniformly comply, it is advisable to elicit his advice.

Note to follow par. 1, Regulation 15, page 38.

Answer 3.—In electrical stations, there are often auxiliary switchboards away from the main switchboard, *e.g.*, near rotary converters or in the boiler-house or in condenser pits or pump rooms, etc. Such switchboards are not in an "area set apart for the purposes thereof" if they are placed where people are liable to pass close to them for purposes other than for attendance thereon. In such cases it is necessary, in order to effect the setting apart, to place a rail or fence so as to prevent persons passing along the working platform, or behind if there are bare conductors exposed at the back. If a switchboard is placed where the working platform or back passage-way is used as a passage for other purposes, and consequently is not in an "area set apart for the purposes thereof," it will require to be fenced or enclosed accordingly, and if the space for the working platform or at the back is less than that required by Regulation 17, the apparatus and conductors will require to be totally enclosed, the switches being provided with covers, as on an ordinary factory motor panel.

In transforming sub-stations, the switchboard passage-ways and working platforms are seldom required for purposes other than for the switchboard, but if otherwise used, *e.g.*, for access to a store room, fencing or guarding of the switchgear is required.

Two-panel Switchboards against Wall, Regulation 17.

Question 4.—Where boards are installed consisting of two panels only is it permissible to place these near to a main wall and allow for inspection at either side providing no passage-way?

As addition to end of par., page 41.

Answer 4.—Sometimes narrow switchboards are placed so close to a wall that there is no room for a person to get behind, and there is, in consequence, no "switchboard passage-way" at the back. Although the connections and other parts at the back may be within reach for cleaning, tightening nuts, etc., by the attendant merely putting his arm behind, the arrangement is obviously not desirable for boards which cannot in practice be made dead, as there is risk of danger from shock or burns through short circuit in working thus in such a confined space, and the arrangement would be contrary to the requirements of Regulation 1. Where the exigencies of space require that a board, which cannot in practice be made dead, be placed close up to a wall, the connections and all parts which may require attention should therefore be on the front.

Adequate means of access, Regulation 17.

Question 5.—For E.H.T. switchboards, is it necessary to provide means for exit at each end of the passage-ways? This seems to be advisable.

For insertion after "cut-off" in line 21, page 40.

Answer 5.—It is difficult to make a definite rule as to where there should be alternative means of access, as the danger of a person being trapped in a passage-way depends not only on the length and width of the passage-way, but also on the power available to maintain an arc should one occur, that is to say, on the power which is being supplied to the system. Thus in a short passage-way, say only ten feet in length and of the minimum prescribed width, there might be danger to a person at the far end of the passage in case of an arc occurring at the panel nearest the entrance should there be a large amount of power on the system. Generally, therefore, it is necessary that there should be means of access at each end of a "switchboard passage-way." On the other hand, if the passage-way is very wide, say two or three times the minimum prescribed in Regulation 17, a second means of access may be unnecessary in stations of moderate power.

Protection by Screens and Doors, Regulation 18 (a).

Question 6.—Are either hinged or lift-down doors considered to comply with the requirements for enclosing, which also stipulate that the passage-way must not be obstructed? Hinged doors are obviously advantageous for convenience of operation in certain cases, but it is possible that with such doors the passage-ways must in many cases be temporarily obstructed.

Note to follow par. 1, page 42.

Answer 6.—In the protection of cells by screens or doors the following points should be considered. For most purposes where lift-off screens are used they are preferably made of non-metallic material, such as asbestos slate, as being lighter than iron and less dangerous in view of their being allowed accidentally to touch a live conductor in being lifted on or off. Where doors hinged at the side are used, in order that the passage-way should not be blocked or unduly obstructed, they should be made capable of opening 180°, and there should also be at least 15 inches space between the edge of the door when open 90° and the opposite wall of the passage. Where necessary, in order to provide this clearance, the doors should be divided down the centre, each half being hinged on either side of the cell. Doors may be conveniently arranged to slide on runners, in which case there should be two lines of runners, the doors being hung alternately on the front and back runners, so that any door may be opened without having to move others. Doors of expanded metal offer the advantage that the apparatus can be seen without removing the protection.

Protection otherwise than by Screens or Doors, Regulation 18 (a).

Question 7.—In certain instances, where rooms have been reserved purely for E.H.T. switchgear, it seems unnecessary to provide screens in the front of the cubicles, and advice is required as to whether, in such cases, provided the rooms are kept locked and only accessible to authorised persons, such screens are necessary. An instance can be given, where such screens were recommended, which shows that this matter can be advantageously discussed.

Note to follow new par. 2, page 42.

Answer 7.—Where protection by a rail is adopted, the rail should be at such a distance out from the cells that it is impossible for a person to touch a live conductor from outside the rail. Although only authorised and competent persons (Regulation 15, second par., and Regulation 28) are allowed in such rooms or passage-ways, and there is little danger so far as ordinary routine duties are concerned, this method of protection is not recommended, as when any work has to be done (*e.g.*, cleaning) temporary screens must be provided (Regulation 18 [d]), and experience shows that even authorised and competent persons will take risks, some of which have resulted in serious and even fatal accidents, merely to save themselves the trouble of putting up the temporary screens provided. It is therefore far better to provide permanent screens in the first instance.

Screening of Isolation Switches, Regulation 18 (d).

Question 8.—Where isolating switches are installed to disconnect oil switches or for other purposes, certain instances have arisen where H.M. Electrical Inspector has recommended barriers to be placed between such isolators and the oil switches to protect the operator.

Where isolators and other apparatus, such as current transformers, are mounted in the same cubicle, cannot the transformers be considered as a part of the main conductors, or is it necessary to insert further barriers between such apparatus and the isolating switches?

Note to follow par. (d), page 42.

Answer 8.—Where isolating switches are installed for disconnecting oil switches or other apparatus (*e.g.*, potential or current transformers) or conductors which it may be required to make dead for working upon, the isolating switches should be placed in a separate compartment so as to be entirely screened when the work is in progress.

Temporary screens, although permitted by the Regulation, are not recommended for new work, as experience again proves that even "authorised persons" will fail to use them when provided, and fatal accidents have occurred from such neglect.

Where, however, in existing switchboards, temporary screens are relied upon for screening off the live side of the isolating switches, safe means should be provided for their insertion by the provision of suitable guides.

Screens between phases, Regulation 14 (d).

Question 9.—On E.H.T. installations, under what circumstances are barriers required between adjacent phases? This point has been raised on different occasions and some ambiguity exists.

Note to follow first par., page 38.

Answer 9.—On high-pressure and extra high-pressure switchboards of 2-phase and 3-phase systems, it is desirable that there should be divisions between the phases at all places where an arc is liable to be accidentally started, *e.g.*, at isolating switches, and sufficient space between the conductors of the different phases should be allowed for this purpose.

Provision of Isolating Switches on both sides of Oil Switches on Feeders, Regulation 22.

Question 10.—No provision appears to be made for protecting life by calling for isolators on both sides of each feeder oil-switch when the same could be alive from a sub-station and thus be a source of danger. Manufacturers differ in their views, but they agree that, were some standard adopted it would be beneficial, as, seeing that competition is largely on price, there is a definite tendency to omit such safeguards in order to cheapen the cost of the switchgear installation.

Note to follow par. on Regulation 22, page 46.

Answer 10.—On high-pressure and extra high-pressure switchboards, it is recommended that isolating switches should be placed on both sides of oil-switches on feeder circuits where the feeders are capable of being made live from the distant end.

Potential Transformer Fuses, Regulation 5.

Question 11.—Certain shunt transformers are constructed with the E.H.T. potential fuses mounted immediately above. Is there any objection to this arrangement; and what facilities for shutting down the switchboard must exist to comply with the correct interpretation of the Electricity Regulation?

Note to follow last par. under Regulation 5, page 27.

Answer 11.—On high-pressure and extra high-pressure switchboards, the bus-bar potential transformers and their fuses, which are generally attached thereto or placed elsewhere in the same compartment, should be protected by isolating switches placed in a separate compartment of the switchboard, so that by means of the isolating switches the transformers and the fuses and all conductors in their compartment can be made dead. This protection is needed in view of the requirements of Regulation 18 (d) should the transformer require attention, as well as in regard to the requirements of this Regulation (5). The objections to the renewal of the fuses whilst the contacts are live are the risk of accident to the attendant through touching a live conductor, even though insulating tongs are used, and through violent rupture of the fuse should one be replaced on a short-circuit due to a faulty transformer.

Definition of "high-pressure."

Question 13.—Are combined traction and three-wire supply switchboards, where the difference of pressure between the positive traction conductors and one of the conductors of the three-wire system exceed 650 volts, to be regarded as high-pressure switchboards?

Answer 13.—In combined traction and three-wire direct-current supply stations, both the traction and three-wire systems are sometimes taken to a common switchboard. Each system by itself is of medium pressure, generally 500 volts for the traction system and a maximum of 500 across the outers for the general supply system. As the traction system has the negative pole earthed, and the lighting system has the neutral conductor earthed, there will be a pressure of 750 volts or so between the positive traction conductor and one of the outers of the supply system. This difference of pressure, although exceeding 650 volts, the limit of medium pressure, exists only between two different systems, and the high-tension regulations do not therefore apply to the switchboard. It is important, however, in such cases, that the fact of this larger difference of pressure between certain conductors should not be overlooked, and particular attention should be paid to the requirements of Regulation 14 (b), (c) and (d).

To follow last par. under Regulation 14, page 38.

In combined traction and lighting switchboards, it should not be overlooked that the pressure between certain conductors will be the sum of the pressure of the traction system and that of one side the three-wire system. Particular attention should therefore be given in regard to such conductors to the requirements (b), (c) and (d) of this Regulation. See also under definition of "high-pressure."

THE OPERATION AND UPKEEP OF ELECTRIC MOTORS.

By E. F. BUTLER.

(*Abstract of an informal paper read before the* Junior Institution of Engineers, *on February 27th*, 1914.)

The objects of maintenance are twofold: first to run the plant with as few stoppages as possible, and secondly, to do so without excessive cost. To get the best results, the upkeep of the plant should be considered before it is installed, and it should be laid out with the objects kept in view of suitability, accessibility, the minimum number of sizes, and everything possible standardised so that the smallest number of spare parts and replacements need be stocked.

A large number of shops belonging to a certain firm were changed over to electric driving by degrees, the process extending over several years. Motors were bought one or two at a time, and, in some cases, simply replaced existing engines. As a result they have over 30 motors, seven of which are over 50 h.p.; out of 26 motors, there are 19 different sizes and nine different makes. If, at the outset, plans had been made to drive the whole of the works, and a modified group drive adopted, a lot of shafting and old-fashioned gearing would have been eliminated, and only about five sizes of motor would have been necessary. The additional first cost would probably have been recovered in less than three years.

In this case, the cost of upkeep is high, as there are too many sorts of motors to keep any spare parts, and so the running of the plant depends entirely on the personal element. One of the best installations from a maintenance standpoint, that is, plant laid out with the object of economical operation and upkeep, is a riverside warehouse handling peas, beans, grains, etc. These are conveyed, sorted, washed, dried, split and sacked. On deciding to go in for electric driving, the owner hired a motor and a recording ammeter. He spent six months in experimenting, and at the end of that time knew exactly what he wanted. As a result there are only three sizes of motors used, all well above their work, and one size of brush fits any motor in the place. Similarly, one of the biggest printing works in London has 130 motors with only four sizes. A spare motor and starter of each size are kept in stock; the complete motor or starter is changed, which takes under half an hour, and the repair is done properly in the workshop.

As one object of maintenance is to prevent breakdowns, an analysis of 100 breakdowns may be given. Thirty-eight were on motors and 62 on control gear.

Of the motors three had damaged shafts, one being broken, one bent, and in one case the armature was loose on the shaft. Six machines had bearing or lubrication troubles, namely, four throwing oil, one hot bearing and one bearing seized. Fourteen stoppages were due to brushes, brush gear, or commutator troubles; in five cases the brushes were worn out, in three cases they were sticking from dirt, in two cases the motor had flashed over due to dirty commutators, in two machines the insulation of the brush spindles had broken down owing to dirt, one machine had the holders loose on the spindle, in the remaining one the wire had become unsoldered in the thimble.

Nine motors had winding troubles, two being burnt-out field coils, four burn-outs were on armatures, in one case the shunt winding was in contact with the compounding, in another the end was knocked off a field coil during cleaning, and in one case there was trouble owing to bad connections between the lugs on the commutator and the ends of the armature coils.

Six were miscellaneous faults and included one earth on terminal box, two armature bands off, one pole piece loose, one wrongly connected, and one had the key out of pinion.

The 62 breakdowns on the control gear were made up as follows:—

Twenty-eight on starters which included 14 contacts or segments burnt, seven resistances burnt out, three handles broken, one arm loose in slate, one no-volt coil burnt out, one arm sticking in full-on position, and one arm not holding up owing to contacts on overload coil not dropping.

Sixteen on fuses; in five cases the fuses had simply blown and were replaced; in the other 11 damage was done usually by bare fuses arcing on to the metal case.

Ten on switches, about half being bad contacts or arcing to cover; the remaining half more or less fell to pieces.

The remaining eight were miscellaneous and comprised the failure of one shunt-breaking resistance, four circuit breakers gave out, in one case the end burnt off the coil, two had burnt contacts, and one was fixed upside down, one starter was condemned by the Home Office and replaced, and two installations had faults on the wiring. Out of a hundred breakdowns, 12 can be considered unavoidable, 17 were overcome by some alteration or modification, and the remaining 71 were due almost entirely to neglect or ignorance—in other words, to lack of maintenance.

The following points should be kept in mind when selecting a motor:—The commutator should be of generous size, to allow for trueing up several times. The segments should be of hard copper, insulated only with pure mica; micanite should be avoided. The ends of the armature coils should be brought

down and soldered directly to the commutator segments. The bands which hold the coils in the slots should not increase the diameter of the armature at all. The stampings under the band should be smaller than the remainder, so that the band comes flush with the surface. This lessens the chance of its coming off, and by not interfering with the clearance gives the bearings a longer life.

The next point to look to is the brush gear. The rocker should be in two pieces so as to allow of its removal if necessary. The insulation of the spindles should be of mica, and the spindles themselves of brass and large enough in diameter to prevent vibration or chattering. The connections from spindle to spindle in machines of more than two poles should be of rod or strip taped and enamelled, and preferably arranged one on the face of the rocker and one on the back to avoid any possibility of them short-circuiting.

In shunt machines it is sometimes an advantage to have the leads to the brush-holders long enough to enable the motor to be reversed by moving the rocker. The holders themselves should be of the type in which the brush slides in a box and is pressed down by an adjustable spring. A screw should be provided to take the end of the flexible connection to the brush, and so prevent the current from passing through the spring; this screw should not be the screw that clamps the holder on to the spindle. It should be possible to remove the holders from the spindle without disturbing anything else. The holders should be so constructed that nearly all the brush can be used up. For ordinary work the bearings should be of hard brass. White metal can be used but requires more supervision. For the heaviest work it is worth while going to a little more expense and using phosphor bronze. In all except the smaller sizes, two oil rings working in separate grooves should be provided. The oil well should be large and painted internally. This provides against any sand being left inside. The cover of the oil well should be hinged and fitted with a spring; this will ensure its being closed. Covers that are loose or hung on pieces of chain usually get lost, and dirt gets in. The overflow should be large enough to carry away excess oil as fast as it can be put in with a pint feeder. The best type of overflow is the one in which a piece of pipe is screwed through the bottom of the oil-well to the right height; the surplus oil then drops clear and does not trickle down the sides of the frame. All field coils should have terminal blocks or connectors to facilitate disconnection for testing. It should be possible to remove the armature from either end of the machine. Any covers that may be fitted should be capable of being put on or taken off while the machine is running, without the possibility of touching live metal or dropping screws or bolts inside. In the case of belt drives slide rails should be provided, and the ends of these should be open. Some makers use square or tee-headed bolts to hold the motor down with nuts on top. A better plan is to have square nuts inside the rails and use setscrews, then if the motor has to be slewed round or moved it can be easily done, otherwise it is necessary to pack up the motor clear of the holding-down bolts and slew it on the packing. The best way to fit a pulley is to fit it up to a shoulder on the shaft with a feather key, tap out the end of the motor shaft and fit a set-screw and a circular plate larger than the shaft. This method is particularly necessary with ball-bearing motors, as the pulley cannot be knocked or wedged off without damage.

(To be concluded.)

PROTECTION OF LARGE POWER SYSTEMS: SEPARATE REACTANCES.

By EUSTACE THOMAS, B.Sc.

The paper read recently by Messrs. Faye-Hansen and Peck, and reproduced in this journal, puts forward a manufacturer's view of the advantages of separate reactances. Some large stations are adopting these, and it is of interest to consider some other aspects of the same question.

The object is to limit currents when short-circuits occur, and thus to diminish: (*a*) the loads which the oil switches may have to break; (*b*) the stresses on the generator windings; (*c*) the liability to shut down the system.

In the first place, it will be accepted as a first principle that each part of the system ought to be strong enough for its obvious duty without outside protection. Thus oil switches ought to be able to open the circuit under any condition that can possibly arise. They are the protectors of the system, and it is wrong and it is unnecessary that they should be too weak for their duty and need extraneous protection. Generator windings should be supported strongly enough to withstand short-circuit conditions, and they can be so built.

These obvious requirements are further strengthened by the fact that reactances afford an imperfect protection only, and cases arise where they do not protect at all. For instance, a very serious shut-down occurred recently in a large system on the station cables, and reactances could not have stopped this. Again, a short in the generator or between it and the reactances finds it quite unprotected. And the reactances themselves actually introduce a further weak link.

In the discussion which followed the reading of the paper in Manchester, the advantage of returning to considerable reactance in the generator windings was put forward, and Dr. Rosenberg appeared to agree with this. Many of the older machines by first-class makers had much higher reactance than modern machines; and the steady short-circuit current at full load excitation was little over one and a-half times full load current. Such machines are not more unsafe nor more expensive, but they would still have to be built to withstand the very much more severe instantaneous conditions at short circuit.

The whole argument for reactances is based on the desire to protect against short circuits. But while there is no real protection unless oil switches and generators are each built to withstand short circuits, as they can be, there is reason to think that precautions can be taken which will practically eliminate short circuits or render them so infrequent that the introduction of more weak links in reactances would introduce much more danger than they remove. Mr. Mackenzie pointed out that in Manchester, although they have had many breakdowns in feeders, some close to the station, they are without noticeable effect on the station itself. Although the cables are three-core, it is the insulation to earth of one core which breaks down first. The station is earthed through a current-limiting resistance, and the relays have a short time limit. The current to earth is thus limited, and before the damage has spread from core to core the cable is cut off. Previously, when long time limits were used, trouble came in.

Dr. Rosenberg endorsed the value of this by anticipating that in the future we may return to single-core feeders instead of three-core. This will ensure that an earth must occur before a short, and will limit the damage. Moreover, single-core cables introduce reactance in themselves, and thus self-protect points far from the station. For long feeders single-core cables might be used for a certain distance, and three-core beyond.

But the same method of protection appears to be applicable to the generators. In these the "active" part of the windings is embedded in iron and the phases are separated by earthed material. But earth shields can be placed between phases on the end connections also. When this is done a breakdown must be to earth; and by discriminating relays and by the limiting earth resistance, the machine can be at once cut out when an earth occurs before the damage has spread. It would be easy also to make the relays at the same time cut off the excitation, and thus limit the damage the machine can do to itself. The relays would include the cables from generators to switchgear, which should be single-core.

The oil switch, above all, calls for urgent attention from station engineers. Considering that the safety of the whole system depends ultimately on these switches, it is astounding what makers will offer and station engineers accept. Switches have been guaranteed to break 20,000 KW. with a few inches of travel with the contacts a very few inches under the surface of a few gallons of oil carried by flimsy tanks. A very small proportion of the cost of space required by reactances would enable large tanks to be used with contacts far below the surface and with long travel. And no one doubts that with a long and rapid break well under the surface of a large body of oil, a circuit can be broken of any capacity that will ever be reached. Switch contacts might be burnt and they and the oil might need replacement; but that is a minor evil which no one would complain of if the system were adequately protected. The present oil switches do wonderfully well considering their size and crudeness, and they show that the construction of a really good switch is not a matter of great cost or difficulty. If money and space can be found for reactances, a part of it can be better spent on the switches.

It would thus appear that protection for large stations is best obtained as follows.—Generators to be designed for higher reactance; generator windings to be strong enough to stand the stress of short circuit; generator end windings separated between phases by earth shields; discriminating relays with small time limit to act when an earth occurs on the machine or cables; generator cables to be single-core; the system to be earthed through a limiting resistance; feeders to be single-core for some distance from the station; oil switches to have contacts buried sufficiently deep in plenty of oil in a strong tank, and to have sufficient break; oil switches to be capable of ready and frequent inspection and cleaning.

There is nothing here to tax an unprejudiced designer; and if station engineers insist on having it all they will get it. But before everything it is time station engineers take the specification of oil switches into their own hands and lay down such rules as will ensure them a more adequate protection than they now get. There is, however, so much to say on this matter that it must be reserved for a further occasion.

Smoke Inspectors' Examination.—On April 24th and 25th, the Royal Sanitary Institution, of 90, Buckingham Palace Road, are holding an examination for smoke inspectors. These examinations are being held from time to time at various centres about the country. We believe this is the first of the series to be held in London, and it is important that this should be known to all who wish to avail themselves of the opportunity of obtaining the Institution's certificate. Other examination centres for this year are Leeds, Manchester, Sheffield, Birmingham and Newcastle.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

Amendments.

NEWFOUNDLAND.—The Government have introduced a Bill by which it is proposed to levy a surtax of 15 per cent. upon the amounts payable in respect of Customs duties on any goods imported with the exception of coal. Whenever it appears to the satisfaction of the Governor in Council that the operation of the above-mentioned surtax is producing a revenue in excess of the requirements of the public service, the Governor may, by Proclamation in the Royal Gazette, reduce the surtax to such an extent as is considered desirable.

AUSTRALIA.—The Commonwealth Government have decided that in the case of commercial travellers' samples imported into Australia a drawback of duty paid may be allowed on re-exportation provided that there is no doubt that the goods have not since importation been "used" (in the ordinary meaning of that term) and that they are worth the duty.

Forms have been laid down for Powers of Attorney given for Customs purposes in the Commonwealth by individuals, firms, or partners to a firm, as appropriate to the circumstances. Copies of these forms are available for inspection by British traders interested, at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

SOUTH AFRICA.—The Union Customs authorities have decided that electric ozonators are to be dutiable at the rate of 12 per cent. *ad valorem* if of British origin and at the rate of 15 per cent. *ad valorem* if foreign.

TURKEY.—The Customs authorities have issued a notice to the effect that no certificates of origin will be required for goods imported into Turkey, to date from March 15th last. The requirement of certificates of origin was instituted during the recent Balkan War.

HONDURAS.—The new tariff of Honduras, which took effect from August 1st last, has created some dissatisfaction, and the Chamber of Commerce of Tegucigalpa has appointed a committee to bring about a revision. The tariff changes recommended by this committee were intended to be presented to the President and to Congress during the present session.

NEW PATENTS APPLIED FOR, 1914.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

7,949. "Spring retaining or controlling devices for tramway points and switches." D. Carnegie and S. C. Gladwyn. March 30th.

7,974. "Telephone transmitter." C. H. Pritchard. March 30th.

7,975. "Electrical heaters." A. E. French. March 30th.

7,984. "Single-line intercommunication telephone systems and apparatus thereof." J. A. Romer. March 30th.

8,010 "Electric Switches." G. Cherbrou. March 30th. (Complete.)

8,019. "Electric heaters." J. R. Quain. March 30th.

8,021. "Devices for the transformation of electrical alternating currents into sound waves, use being made of resonators tuned for different frequencies." Kemp & Lauritzen. March 30th. (Convention date, March 29th, 1913, Denmark.) (Complete.)

8,038. "Switches." G. W. Hart. March 30th. (Convention date, April 1st, 1913, United States.) (Complete.)

8,042. "Vapour electric devices." British Thomson-Houston Co., Ltd. March 30th. (General Electric Co., United States.)

8,049. "Transmitters." J. J. Comer. March 30th. (Convention date, March 31st, 1913, United States.) (Complete.)

8,052. "Electric Recorders." J. S. Withers. March 30th. (Charles O Sanders, United States.) (Complete.)

8,058. "Shade-ring remover for removing the shades from electric lamp-holders." L. W. Turton. March 31st.

8,062. "Protective casing for electric cables." R. McGeoch. March 31st.

8,118. "Electrolytic meters." H. S. Hatfield and G. Hookham. March 31st.

8,131. "Electric accumulators." Tudor Accumulator Co., Ltd. March 31st. (Lorenz Lucas, Germany.) (Complete.)

8,135. "Attachment of electrical conduit tubes to junction pieces." T. A. Smith and W. H. Owen. March 31st.

8,138. "Composition of matters to be used as an insulating-compound." T. J. Hadley. March 31st. (Complete.)

8,145. "Electric incandescent lamps." W. Keppel. March 31st. (Complete.)

8,146. "Instrument for measuring Rontgen rays." R. Grisson. March 31st. (Convention date, April 25th, 1913, Germany.) (Complete.)

8,147. "Cooling device for the electrodes of vacuum tubes, particularly Rontgen tubes." March 31st. R Grusson. (Convention date, October 14th, 1913, Germany.) (Complete.)

8,148. "Dynamo machines." H. Leitner. March 31st.

8,166. "Electrolytic apparatus for preparing solutions for bleaching and other purposes." O. Sumner. March 31st.

8,173. "Protection of alternating-current electric generators, rotary converters, and the like." British Thomson-Houston Co., Ltd., and F. H. Clough and J. Whitcher. March 31st.

8,174. "Electric lamps." British Thomson-Houston Co., Ltd. March 31st (Allgemeine Elektricitats-Ges., Germany.)

8,178. "Automatic starters for dynamo-electric machines." F. Newton and Newton Bros. March 31st. (Complete.)

8,184. "Construction and method of arranging induction coils for loading duplicatable double telephone lines worked on the Pupin system." H. B. M. Pleijel and A. H. Olsson. March 31st. (Convention date, May 13th, 1913, Sweden.) (Complete.)

8,185. "Construction and method of arranging induction coils for loading duplicatable double overhead telephone lines worked on the Pupin system." H. B. M. Pleijel and A. H. Olsson. March 31st. (Convention date, May 9th, 1913, Sweden.) (Complete.)

8,189. "Starters and combined starter regulators for electric motors." J. G. Stirk. April 1st.

8,218. "Electric self-starter for internal-combustion engines." R. W. Pruggmayer. April 1st.

8,224. "Electric flashing and constant contact combined switches for pocket and dry flash batteries." J. W. Mander. April 1st.

8,239. "Telephone system in which the lines are interconnected by the aid of electro-mechanically controlled switches." F. Aldendorff. April 1st. (Addition to 2,530/14.)

8,258. "Polyphase-commutator electric machines." Siemens-Schuckertwerke G.m.b.H. April 1st. (Convention date, April 3rd, 1913, Germany.) (Complete.)

8,269. "Recording pyrometers, galvanometers, barometers and like instruments." A. Onwood. April 1st.

8,280. "Periodical interrupter for electric circuits and more particularly applicable to heating-apparatus." R. Arno. April 1st. (Complete).

8,286. "Safety devices for electrical winding mechanism." H. Wauchope and Stothert & Pitt, Ltd. April 1st.

8,310. "Apparatus for switching on and illuminating advertisements in connection with a liquid-spray diffuser." F. Krauss. April 2nd. (Complete.)

8,336. "Speed indicator and controlling device for vehicles, motor-cars, and the like, having or being driven by internal-combustion or other means of mechanical or electrical propulsion." J. P. Haworth. April 2nd.

8,345. "Fronts of electric and other lamps." W. H. Dee and F. J. Edginton, trading as W. H. Dee & Co. April 2nd.

8,349. "Electric plug connectors." M. Matthaey & Co., G.m.b.H., and H. Eickmann. April 2nd. (Convention date, April 2, 1913, Germany.) (Complete.)

8,353. "Pocket electric lamps adapted to be used as target-illuminating devices for pistols and the like." P. Schmidt and C. Dobslaw. April 2nd. (Convention date, April 28th, 1913, Germany.) (Complete.)

8,358. "Alloys for dental, electrical, and other purposes." R. Marston and R. W. Marston. April 2nd.

8,360. "Electrical terminals." E. R. Beney. April 2nd.

8,367. "Electrolytic apparatus." Maschinenfabrik Surth G.m.b.H. April 2nd. (Convention date, September 3rd, 1913, France). (Complete).

8,369. "Electrical control of signals." Compagnie de Signaux Electriques pour Chemins de Fer. April 2nd. (Convention date, April 3rd, 1913, France.) (Complete.)

8,370. "Electrical control of signals." Compagnie de Signaux Electriques pour Chemins de Fer. April 2nd. (Convention date, April 3rd, 1913, France). (Complete.)

8,385. "Rotary converters provided with boosters." E. Rosenberg. April 2nd.

8,398. "Railless electrical vehicles." W. H. Turner and W. H. Isherwood. April 3rd.

8,404. "Electrically-heated boiling apparatus." Frederick Barron. April 3rd.

8,441. "Pocket and other electric flash-light batteries." J. W. Mander. April 3rd.

8,442. "Pocket and other electric flash-light batteries." J. W. Mander. April 3rd.

8,456. "Combination electric switch and fuse." A. H. Short. April 3rd.

8,465. "Gas and electric flash signs and the like." R. J. Crouch. April 3rd.

8,473. "Indicating-devices for electric installations." Siemens Bros. & Co., Ltd., and W. H. Grinsted. April 3rd. (Complete).

8,499. "Electric cut-outs." British Thomson-Houston Co., Ltd. April 3rd (General Electric Co., United States).

8,504. "Electric time switches." P. Dresla. April 3rd. (Convention date, April 3rd, 1913, Germany). (Complete).

8,505. "Arc-light carbons." H. Ayrton. April 3rd. (Addition to 22,319/13)

8,512. "Electric furnaces." J. L. Dixon. April 4th.

8,513. "Electric furnaces." J. L. Dixon. April 4th.

8,526. "Electrical indicating-apparatus." H. M. Harding. April 4th.

8,565. "Alternating electric-current machines having bar winding." Allmanna Svenska Elektricka Aktiebolaget. April 4th. (Convention date, April 11th, 1913, Sweden). (Complete.)

8,595. "Electric welding machines." Allgemeine Elektricitats Ges. April 4th. (Convention date, April 4th, 1913, Germany). (Complete).

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1913.

12,076. Apparatus for use in Wireless Telephony. W. T. Ditcham & Grindell-Matthews Wireless Telephone Syndicate, Ltd. May 23rd.

12,129. Apparatus for Heating Liquids Electrically. British Electric Heater Co., and C. Kratt. May 24th.

12,157. Switching Arrangements for use in Wireless Telephony and Wireless Telegraphy. W. T. Ditcham and Grindell-Matthews Wireless Telephone Syndicate, Ltd. May 24th.

12,872. Annealing of Wire. M. Woods. June 4th.

13,903. Methods of Exciting Rontgen Ray Tubes. Siemens & Halske Akt. Ges., K. Bangert & E. Utecht. June 16th. (Additions to 9,499/12.)

14,229. Telephone Exchange or Other Switching Systems. Telephon Apparat Fabrik E. Zwietusch & Co. June 19th. (July 5, 1912.)

14,427. Magnetic Separators. Fried Krupp Akt. Ges. Grusonwerk. June 21st. (July 15th, 1912.)

14,795. Methods of and Apparatus for Sintering Metal. R. B. Walling. June 28th. (October 7th, 1912.)

14,951. Arrangements for Controlling the Feed of Recording Instruments. Siemens Bros. & Co. (Siemens & Halske Akt. Ges.) June 28th.

15,286. Joining or Binding the Junctions of Metallic Sheathing or Armouring of Electric Conductors. L. Sunderland. July 2nd. (Addition to 22,550/11.)

16,396. Manufacture of Porcelain Articles. J. A. Jeffery and B. A. Jeffery. July 16th.

16,468. Processes of Making Boron Nitride. British Thomson-Houston Co. (General Electric Co.) July 17th.

16,641. Railway-signalling Apparatus. Soc. d'Electricite Nilmelior & J. E. Colas. July 16th. (July 20th, 1912. Addition to 827/10.)

17,713. Electric Lamp Signalling. Siemens Bros. & Co. (Siemens Halske Akt. Ges). August 1st.

18,728. Spark-plug Socket for Oil and Gas Engines. E. C. Male. August 18th.

19,268. Electric Clocks. T. Rushton. August 25th. (Addition to 10,100/13.)

1914.

340. Electric Switches. G. W. Hart. January 6th.

357. Sparking Plugs. O. Freiberg & O. Petzsche. January 6th. (October 8th, 1913.)

1,729. Connections and Fittings for Electric Conduits. C. Birch. January 22nd.